

SIGNAL SECTION ADVANCE NOTICE

ASSOCIATION OF AMERICAN RAILROADS

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REPORTS

to be presented at the

Fifty-Fourth Annual Meeting

QUEBEC, QUE., CANADA

September 29, 30 and October 1, 1952

RULES OF ORDER

RESULT OF 1951 LETTER BALLOT

PRINTED IN U. S. A.

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ASSOCIATION OF AMERICAN RAILROADS
SIGNAL SECTION

COMMITTEE REPORTS

1951 Fiscal Year

(September 12, 1951—October 1, 1952)

Fifty-Fourth Annual Meeting

Chateau Frontenac

Quebec, Que., Canada

September 29, 30 and October 1, 1952

ASSOCIATION OF AMERICAN RAILROADS

OPERATIONS AND MAINTENANCE DEPARTMENT

ENGINEERING DIVISION

Signal Section

Office of the Secretary, 59 East Van Buren Street, Chicago 5, Ill.

J. H. AYDELOTT
VICE-PRESIDENT
Operations and Maintenance
Department

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- I. ECONOMICS OF RAILWAY SIGNALING.
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- II. INTERLOCKING.
H. A. Hudson, Southern Ry., Chairman.
- III. SIGNAL SHOP PRACTICE.
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- IV. AUTOMATIC BLOCK SIGNALING.
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- XI. ELECTRONICS.
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W. S. Storms	E. A. Warner*

Signal Section, A.A.R.:

The following outline of work has been assigned:

1. Revision of Manual.
2. Indexing signal literature.
3. Report on the economics of railway signaling.

The Committee submits for consideration, reports on the following subjects**:

3. Economics of controlled propane gas switch heaters.

Economics of automatic block signaling as compared with train order operation only on Canadian Pacific Ry., Chapleau to Schreiber, Ont., Canada.

Effect of various classes of track on taxation.

Economics of roller bearings for switches.

Economics of high-speed turnouts on Norfolk & Western Ry.

Economics of controlled manual block and train order operation on 19.6 miles of single-track main line of the Chicago & Eastern Illinois R.R. between Findlay Junction and Pana, Ill.

Train hour value.

Track and roadway maintenance expenses—per equated track mile.

Economics of new yard facilities on the Union Pacific R.R. at North Platte, Nebr., including car retarder classification yard.

Economics of centralized traffic control versus multiple track postponing additional main tracks.

Economics of single main track with centralized traffic control replacing two main track operation between Green Island and Marion, Iowa on the Chicago, Milwaukee, St. Paul & Pacific R.R.

* Consulting Member.

** Suggestions or criticisms should be submitted in writing to the Chairman of the Committee on or before September 1, 1952.

Economics of the conversion of second main track to a yard track and the installation of remote control with train operation by signal indication on the Southern Ry. at Inman Yards, Atlanta, Ga.

Economics of "off track" equipment.

Disposition of 1951 Letter Ballot Subject

The following subject presented by Committee I at the 1951 Annual Meeting was submitted to letter ballot and officially approved:

Conclusions and Findings—Obsolete—Removed from Manual Part 103.

ECONOMICS OF CONTROLLED PROPANE GAS SWITCH HEATERS

For many years, the removal of snow and ice from switches, movable point frogs and derails has been accomplished manually using portable snow-melting equipment, brooms and shovels. This method of snow and ice removal is costly. In addition, it is frequently necessary to recruit unskilled men from outside the railroad, which entails the many payroll complications for part-time employees. Furthermore, since these men are unfamiliar with railroad safety rules, they endanger themselves, other employees, and safety of operation, with attendant potential legal difficulties.

In yards and terminals, where there are regular railroad employees to start and stop the operation, it has become common practice to install, prior to the winter season, permanent snow-melting devices of various types, including those using steam, commercial gas, or electricity.

At remote locations, such permanent installations were not feasible until recently when the availability of "bottled" propane gas spurred the development of dependable ignition control, and indication.

The electrical features in the control of the ignition and the indication that the gas is lighted, transmitted either by direct wire or by code of a traffic control system, have been developed to the point where they may be installed with virtual assurance that such control will function as intended regardless of the severity of the weather. With improvement of controls, gas-burning switch heaters are being used more extensively for the successful removal of snow and ice from switches at outlying locations.

Since the cost of train operation and the cost of train stops have increased steadily, it is important to expedite trains, reduce delays, reduce stops and reduce operating expense in every possible way.

An economic study to forecast the results obtainable through the installation of either manual or remote-controlled gas switch heaters, in lieu of manual removal, may show, in some instances, a saving in train time and train stops in addition to the saving in labor, hand tools and supplies.

The following economic report shows an appreciable annual return on the capital investment resulting from an installation on an eastern railroad now using extensively direct wire and code controlled propane gas switch heaters with very satisfactory results.

Propane gas switch heaters were installed at 17 locations with a total of 57 switches and 2 derails equipped.

The 57 switches and 2 derails consisted of:

- 21 switches with 16-foot switch points with a 20-foot switch heater having 2 inspirators on each stock rail.
- 2 switches with 22-foot switch points with a 22-foot switch heater having 2 inspirators on same stock rail.
- 1 switch with 24-foot switch points with a 24-foot switch heater having 3 inspirators on each stock rail.
- 33 switches with 30-foot switch points with a 34½-foot switch heater having 3 inspirators on each stock rail.
- 2 Hayes derails with a 6½-foot switch heater having 1 inspirator on the stock rail.

Of the 57 switches and 2 derails, the heaters on 54 switches and 2 derails have hot wire ignition, 2 switches have spark ignition and 1 switch has three types of ignition for test, viz., hot wire on one section of heater, spark using high tension ignition coils on second section of heater, and spark using a propane gas-driven magneto on the third section of the heater.

Heaters on 37 of the switches are provided with return indication and the heaters on 20 of the switches and the 2 derails are not provided with return indication.

Heaters on 31 switches are controlled by code; heaters on 6 are remote-controlled by direct wire, 1 controlled over a simplex on a telephone circuit, and 21 are controlled by direct wire from local towers.

Energy for ignition is furnished by a storage battery housed at each switch. The storage batteries of the lead plate type have a rated capacity of 220 ampere-hours and are charged at the end of a season and stored for use the following season. One location has a set of trickle charged nickel iron storage cells rated at 112 ampere-hours in use for test.

Propane gas for use with switch heaters is either stored in cylinders or bulk tanks: 28 switches and 1 derail are furnished propane gas from 100-pound cylinders with a total of 492 cylinders; 246 cylinders are in use for normal operation, and 246 cylinders are in use for stand-by; 29 switches and 1 derail are furnished propane gas from bulk tanks consisting of thirteen 1,800-gallon, four 500-gallon and one 2,500-gallon (water capacity) tanks.

Of the 492 cylinders of propane gas in use, 262 cylinders were purchased by the railroad at a cost of \$16.50 each. The balance of the cylinders and the bulk storage tanks are under lease.

The total switch heater burning hours for the 1950-51 winter, for the heaters on the 57 switches and 2 derails, was 10,068 hours, consuming a total of 110,531 pounds of propane gas at a total cost of \$5,370 or an average cost of \$0.0485 per pound of propane gas.

The average number of hours of switch heater operation amounts to:

$$\frac{10,068}{59} = 171 \text{ hours}$$

The average consumption of propane gas per switch or derail heater amounts to:

$$\frac{110,531}{59} = 1,873 \text{ pounds}$$

The average consumption of propane gas per switch or derail heater per hour amounts to:

$$\frac{1,873}{171} = 11 \text{ pounds per hour}$$

The average cost of propane gas per hour of switch heater operation amounts to:

$$\$0.0485 \times 11 = \$0.5335$$

This is the over-all average cost per hour of propane gas for switch heater operation. It may be approximately broken down as to average hourly cost for the different heater lengths in use as follows, based on the gas consumption of the inspirators:

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The heaters on the 57 switches and 2 derails have a total of 298 propane gas inspirators and the average number of inspirators per switch amounts to:

$$\frac{298}{59} = 5.05 \text{ inspirators}$$

The average consumption of gas per hour of switch heater operation per inspirator amounts to:

$$\frac{1,873}{5.05 \times 171} = 2.1 \text{ pounds}$$

Approximate consumption of propane gas for the individual heaters on the switches and derails is:

Derail heaters consumed

$$2.1 \times 1 \text{ inspirator} = 2.1 \text{ pounds of propane gas per hour}$$

Heaters on 16-foot switch consumed

$$2.1 \times 4 \text{ inspirators} = 8.4 \text{ pounds of propane gas per hour}$$

Heaters on 22-foot switch consumed

$$2.1 \times 4 \text{ inspirators} = 8.4 \text{ pounds of propane gas per hour}$$

Heaters on 24-foot switch consumed

$$2.1 \times 6 \text{ inspirators} = 12.6 \text{ pounds of propane gas per hour}$$

Heaters on 30-foot switch consumed

$$2.1 \times 6 \text{ inspirators} = 12.6 \text{ pounds of propane gas per hour}$$

from which the average cost per hour of gas consumed by the different heaters is:

$$\text{Derail heaters cost } 2.1 \times \$0.0485 = \$0.102 \text{ per hour}$$

$$\text{Heaters on 16 or 22-foot switch cost } 8.4 \times \$0.0485 = \$0.407 \text{ per hour}$$

$$\text{Heaters on 24 or 30-foot switch cost } 12.6 \times \$0.0485 = \$0.611 \text{ per hour}$$

The manual cost of snow and ice removal at both ends of a siding based on actual charges amount to:

Trackmen, straight time.....	1,056 hours	@ \$1.258 =	\$1,328
Trackmen, penalty time.....	432 hours	@ 1.887 =	815
Trucking of kerosene.....	144 hours	@ 1.366 =	197
Kerosene.....	3,750 gallons	@ 0.10 =	375
			<u>\$2,715</u>
Plus 10% account of labor and material increases.....			271
Total cost of manual snow and ice removal at both ends of siding.....			\$2,986
Cost of manual snow and ice removal for one end of siding.....			\$1,493

An estimated cost of manual snow and ice removal from 7 separate switches and four groups of switches of 4, 5, 5, and 8 switches respectively, making a total of 29 switches in all, is \$25,500 with an average cost of \$880 per switch.

The 57 switches and 2 derails are grouped as follows: one group each of 8, (6 and 1 derail), (5 and 1 derail), four groups each of 5, one group each of 4 and 3, five outlying single switches, two sidings and two switches at ends of a single track which is over a long bridge.

Using the manual snow and ice removal cost of \$2,986 for sidings, \$1,493 for single switches, and the average cost of \$880 for the switches in the various groups, the manual snow and ice removal cost for the 57 switches and 2 derails would be:

8 switches.....	@ \$ 880 =	\$ 7,040
6 switches and 1 derail.....	@ 880 =	6,160
5 switches and 1 derail.....	@ 880 =	5,280
4 groups of 5 switches.....	@ 880 =	17,600
4 switches.....	@ 880 =	3,520
3 switches.....	@ 880 =	2,640
5 outlying single switches.....	@ 1,493 =	7,465
2 sidings.....	@ 2,986 =	5,972
2 switches at the ends of single track.....	@ 1,493 =	2,986
Cost of manual snow and ice removal at the 57 switches and 2 derails.....		\$58,663

The actual cost of 1950-51 removal of snow and ice by means of the propane gas switch heaters on the 57 switches and 2 derails amounted to:

Cost of propane gas for 57 switches and 2 derails.....	\$5,370
Cost of installing and removing heaters.....	1,773
Cost of handling propane gas.....	617
Cost of maintenance including cost of damage by dragging equipment and overtime.....	2,990
One-third of 3-year lease charge for bulk tanks of \$2,826.....	942
Cost of snow and ice removal by means of switch heaters.....	\$11,692
Cost of manual removal of snow and ice.....	\$58,663
Cost of snow and ice removal by means of switch heaters.....	11,692
Savings in operating cost.....	\$46,971
Reduction in operating cost.....	80%

There is also a non-recurring lease charge of \$1,260 for one of the bulk tanks which reduces the saving in operating cost for the first year by \$1,260, or 2.7 per cent.

Economic Statement(Covering installation of propane gas switch heaters on
57 switches and 2 derrails)

1. Cost of Installation:	
(a) Capital Investment.....	\$76,859
(b) Operating Expenses.....	—
(c) Total.....	<u>\$76,859</u>
2. Annual Operating Expenses before Installation.....	\$58,663
3. Annual Operating Expenses after Installation.....	<u>11,692</u>
4. Net Reduction in Annual Operating Expense.....	\$46,971
5. Deduction for Interest Charges @ 6% (of 1-a).....	<u>4,612</u>
6. Net Saving per Annum.....	<u>\$42,359</u>
7. Annual Return over 6% Interest:	
(a) On Capital Investment ($6 \div 1-a$).....	55.1%
(b) On Total Cost ($6 \div 1-c$).....	55.1%

Action Recommended

Acceptance as information.

ECONOMICS OF AUTOMATIC BLOCK SIGNALING AS
COMPARED WITH TRAIN ORDER OPERATION ONLY
ON CANADIAN PACIFIC RY., CHAPLEAU TO
SCHREIBER, ONT., CANADA

In 1943 the Canadian Pacific Ry. completed the installation of automatic permissive block signaling between White River and Schreiber, Ont., Canada, 118.3 miles, and in 1944 from Chapleau to White River, 129.9 miles. Each territory comprises an operating subdivision of the Canadian Pacific trans-continental route.

These installations represent segments of an extensive signaling program by the Canadian Pacific Ry. for the purpose of increasing the safety of operation and improving train performance. Studies by the Railroad, based on peak traffic periods, show that the installation of automatic block signaling on a single-track subdivision has increased the capacity about 20 per cent, in terms of the number of trains which can be handled without delays.

The line traverses rolling territory. Between Chapleau and White River the maximum grades are 1 per cent for 4.5 miles eastward, and 1.6 per cent for 4.2 miles westward. Between White River and Schreiber, the westward ruling grade is 1.1 for 3 miles, and eastward 1.3 per cent for 3 miles. Curves are numerous, to the extent that sections of tangent more than a mile are very rare. The maximum curvature is 8 degrees but for the most part does not exceed 6 degrees.

In general, the passing tracks are fairly close: 4.5 to 5 miles apart. Between Chapleau and White River, 129.9 miles, there are 24 sidings, and on the 118.3 miles between White River and Schreiber there are 22 sidings. The turnouts are No. 11 and the switches are hand-thrown except in a few instances where included in interlockings.

Traffic volume varies with the seasons depending on tourist business and the movement of principal commodities, especially grain. Schedules include six passenger and eight freight trains daily, but in peak seasons have reached as many as 32 movements daily.

Train movements are authorized by time-table and train order and, in addition, prior to the automatic signaling installation, a "time block" arrangement was in effect; for example, out of any open office, there was a 20-minute block behind every passenger train. Trains other than passenger were blocked at 10 minutes except when closing in at stations. Such arrangement caused numerous delays and were more pronounced because of inability to maintain open telegraph offices at desired frequency.

Since the installation of automatic block signaling, train movement has been accelerated, accompanied by increased safety of operation.

The cost of automatic block signaling installations follows:

Chapleau to White River	129.9 miles	\$646,173 Capital
White River to Schreiber	118.3 miles	\$513,000 Capital

After the block signal installations, there was an increase in tons per train, reduction in train hours, saving in overtime hours, and reduction in fuel consumed. Also, track patrol service was discontinued on Sundays and Holidays.

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Comparison of operating statistics for a period of one year "before" and one year "after" the signaling installation, reveals:

(Freight Service)	White River Subdivision Chapleau to White River		Heron Subdivision White River to Schreiber	
	Before	After	Before	After
Gross ton-miles (thou- sands).....	1,183,720	1,118,384	915,130	1,017,198
Train miles.....	749,000	687,000	665,000	716,000
Avg. tons per train east- ward (predominating direction).....	1,740	1,795	1,485	1,545
Train hours.....	44,664	33,120	34,920	37,680
Avg. miles per hour.....	16.8	20.7	19.0	19.0
Train overtime hours per 1,000 train miles.....	11.0	0.81	5.4	4.3
Overtime saving one year	\$47,700		\$4,680	
Fuel saving per 1,000 GTM:				
Eastward.....	6 lbs.		3 lbs.	
Westward.....	4 lbs.		6 lbs.	
Fuel saving for one year..	3,068 tons		1,907 tons	
	\$21,200		\$13,100	
Saving in track patrol service.....	\$4,080		\$4,080	

Summary of Advantages

1. Increased tons per train.
2. Reduction in freight train hours.
3. Reduction in overtime hours.
4. Increased miles per train hour.
5. Reduced fuel consumption.
6. Saving in track patrol forces.
7. Increased safety of train movement.
8. Increased main track capacity.

Action Recommended

Acceptance as information.

EFFECT OF VARIOUS CLASSES OF TRACK ON TAXATION†

The State and Local taxes per mile of track operated in 1950 vary from a minimum of \$181 to a maximum of \$4,163, with a composite average for 78 railroads, of \$865. This information has been developed through cooperation with the Bureau of Railway Economics, A.A.R. and is shown in the following table:

TABLE I
State and Local Taxes per Mile of Track Operated
Calendar Year 1950

Railroad	Total miles of all track operated at close of year	State and local taxes*	
		Total	Per mile of track operated
NEW ENGLAND REGION:			
1 Bangor & Aroostook.....	872.87	\$627,311	\$719
2 Boston & Maine.....	3,231.63	2,955,013	914
3 Central Vermont.....	612.22	153,087	250
4 Maine Central.....	1,326.23	876,820	661
5 New York, New Haven & Hartford.....	4,230.40	5,524,190	1,306
6 Rutland.....	522.67	136,877	262
GREAT LAKES REGION:			
7 Grand Trunk Western.....	2,155.23	680,193	316
8 Erie (Incl. Chgo. & Erie).....	5,665.64	5,738,037	1,013
9 New York, Chgo. & St. Louis (Incl. W. & L.E.).....	3,976.31	3,644,106	916
10 Delaware & Hudson.....	1,731.98	1,562,626	902
11 Delaware, Lackawanna & Western.....	2,408.94	4,403,715	1,828
12 Lehigh & New England.....	323.14	219,652	680
13 Lehigh Valley.....	2,937.57	3,079,058	1,048
14 Monongahela.....	285.64	176,198	617
15 New York, Ontario & Western.....	823.62	148,748	181
16 New York Central (Incl. B. & A.).....	24,092.81	29,393,313	1,220
17 Pittsburgh & Lake Erie.....	1,048.25	1,126,320	1,074
18 Ann Arbor.....	418.44	221,965	530
19 Wabash.....	4,314.91	2,137,231	495
CENTRAL EASTERN REGION:			
20 Baltimore & Ohio.....	12,065.77	8,623,207	715
21 Bessemer & Lake Erie.....	575.80	454,227	789
22 Chicago & Eastern Illinois.....	1,597.52	760,017	476
23 Chicago, Indianapolis & Louisville.....	817.40	399,929	489
24 Detroit, Toledo & Ironton.....	689.30	549,756	798
25 Elgin, Joliet & Eastern.....	1,080.37	1,199,934	1,111
26 Illinois Terminal.....	657.94	454,615	691
27 Long Island.....	911.63	3,795,380	4,163
28 Pennsylvania.....	25,109.59	27,602,904	1,099
29 Cent.R.R. of New Jersey (Incl. C.R.R. of Pa.).....	1,737.48	3,349,283	1,928
30 Reading.....	3,326.18	2,624,910	789
31 Western Maryland.....	1,400.31	1,366,654	976
POCAHONTAS REGION:			
32 Chesapeake & Ohio (Incl. Pere M.).....	9,933.52	12,501,983	1,259
33 Norfolk & Western.....	4,736.55	6,984,376	1,475
34 Richmond, Fred'burg & Potomac.....	483.87	790,303	1,633
35 Virginian.....	1,096.51	1,955,387	1,783
SOUTHERN REGION:			
36 Atlantic Coast Line.....	7,826.27	4,827,736	617
37 Clinchfield.....	480.27	1,018,304	2,120
38 Louisville & Nashville.....	7,951.36	7,987,958	1,005
39 Nashville, Chattanooga & St. Louis.....	1,714.10	1,085,609	633
40 Florida East Coast.....	1,225.58	986,481	805
41 Gulf, Mobile & Ohio (Incl. Alton).....	4,318.91	2,690,430	623
42 Central of Georgia.....	2,694.79	1,376,151	511
43 Illinois Central (Incl. Y. & M. V.).....	11,200.52	11,619,540	1,037
44 Norfolk Southern.....	819.97	267,853	327
45 Seaboard Air Line.....	5,885.63	4,053,795	689
46 Alabama Great Southern.....	662.10	669,210	1,011
47 Cincinnati, New Orleans & Tex. Pac.	884.28	1,628,250	1,841
48 Southern.....	10,409.46	8,756,781	841

* Represents total accruals other than United States Government taxes.

† Previous report on this subject appears in A.A.R. Signal Section 1950 Proceedings, Vol. XLVIII, pp. 36 and 390.

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Com. I—Economics of Ry. Signaling

TABLE I—Continued

Railroad	Total miles of all track operated at close of year	State and local taxes*	
		Total	Per mile of track operated
NORTHWESTERN REGION:			
49 Soo Line (Incl. Wis. C.)	5,465.16	\$2,283,897	\$418
50 Chicago & North Western	12,120.29	6,395,090	528
51 Chicago, St. Paul, Minneapolis & Omaha	2,418.41	1,179,639	488
52 Chicago Great Western	2,167.70	911,546	421
53 Chicago, Milwaukee, St. Paul & Pacific	15,893.72	9,097,823	572
54 Duluth, Missabe & Iron Range	1,199.04	2,316,790	1,932
55 Great Northern	12,199.09	11,604,744	951
56 Minneapolis & St. Louis	1,762.92	628,824	357
57 Northern Pacific	10,636.57	8,501,200	799
58 Spokane, Portland & Seattle	1,265.51	1,306,480	1,032
CENTRAL WESTERN REGION:			
59 Atchison, Topeka & Santa Fe	21,416.97	17,559,868	820
60 Chicago, Burlington & Quincy	13,667.10	9,713,772	711
61 Colorado & Southern	1,192.93	622,732	522
62 Fort Worth & Denver	1,439.75	391,952	272
63 Denver & Rio Grande W. (Incl. D. & S. L.)	3,822.88	3,095,523	810
64 Rock Island System	11,279.61	6,316,066	560
65 Northwestern Pacific	465.31	209,300	450
66 Southern Pacific	13,291.56	17,147,185	1,290
67 Union Pacific	15,826.27	16,363,317	1,034
68 Western Pacific	1,920.13	1,115,730	581
SOUTHWESTERN REGION:			
69 El Paso Lines	6,783.98	4,143,947	611
70 Kansas City Southern	1,439.11	1,358,682	944
71 Louisiana & Arkansas	1,008.61	656,027	650
72 Missouri-Kansas-Texas	4,685.89	2,284,128	487
73 Gulf Coast Lines	1,684.95	608,282	361
74 International-Great Northern	1,465.68	458,365	313
75 Missouri Pacific	10,483.84	6,150,867	587
76 Texas & Pacific	2,712.30	1,396,296	515
77 St. Louis Southwestern	2,316.81	1,454,628	628
78 Texas & New Orleans	6,141.44	2,969,801	484
Composite Average	371,444.91	321,425,924	865
AVERAGES BY REGIONS:			
New England	10,796.02	10,271,298	951
Great Lakes	50,182.48	52,531,162	1,047
Central Eastern	49,969.29	51,180,816	1,024
Pocahontas	16,250.45	22,232,049	1,368
Southern	56,073.24	46,968,098	838
Northwestern	65,128.41	44,226,033	679
Central Western	84,322.51	72,535,445	860
Southwestern	38,722.51	21,481,023	555

* Represents total tax accruals other than United States Government taxes.

Action Recommended

Acceptance as information.

ECONOMICS OF ROLLER BEARINGS FOR SWITCHES

The adoption of heavier rail and longer switch points by practically every railroad created a problem in the handling of switches. For mechanical switches, increased manual force became necessary for their operation, or additional power was required for air or electric switches.

To reduce the load created by heavier rail and longer switch points, roller bearings were designed and have been in use since 1932. These bearings consist of a roller portion and a bearing plate. When movement occurs, approximately 80 per cent of the weight of the switch is supported on the roller bearings, thereby materially lessening the force required for such movement.

In 1946* Committee II—Interlocking canvassed the membership to determine the extent of use and the benefits derived from roller bearings on switches. Such inquiry developed that roller bearings were being used by 43 railroads, with 2,933 switches being so equipped. The specific advantages of roller bearings are summarized as follows:

1. Improves the over-all operation, whether used in conjunction with power-operated, mechanically operated, or spring, switches.
2. Reduces power consumption and operating time for power-operated switches.
3. Decreases wear of connections and operating mechanism, especially when switch plates become dry or dirty.
4. Enables substitution of longer and heavier points for mechanically operated switches.
5. Permits the successful operation of mechanical switches farther removed from the control point.
6. Reduces complaints from levermen with respect to the difficulty in operating mechanical switches.
7. Improves the performance of spring switches through reduced friction when points return after a trailing movement.
8. Where facing point lock is used on a spring switch, roller bearings materially aid the return of the points to normal position in relation to the stock rail at the point where lock connection is attached.

In addition, a number of tests were conducted on certain type switches, with and without roller bearings, which definitely proved the superiority of roller bearing switches.

A recent survey of several large users has substantiated the previous favorable reports and has also developed that the use of roller bearings has reduced signal failures due to sanding; also, the use of roller bearings has reduced the frequency of cleaning and oiling.

It is unfortunate that the economic aspects of roller bearings cannot be readily developed because there are a number of unknown quantities that are difficult to evaluate. Undoubtedly, however, there are instances where the use of roller bearings on switches has permitted the continued use of mechanically operated switches when heavier rail is laid; furthermore, they have alleviated labor complaints.

* A.A.R. Signal Section 1946 Proceedings, Vol. XLIV, p. 66-A.

In the absence of roller bearings, the railroads would doubtless be confronted with the necessity of greater expenditures either of capital money or operating expense for handling the longer and heavier switches. It might become necessary to replace mechanical switches with power mechanism and also to make changes in power mechanisms, especially where low-voltage switch machines are used.

The continued and expanded use of roller bearings on switches appears to be well justified by the improved operation and other benefits thereby made possible. The economics of any particular installation can readily be determined by each railroad in comparison with the cost of treatment that would otherwise be necessary.

Action Recommended

Acceptance as information.

ECONOMICS OF HIGH-SPEED TURNOUTS ON
NORFOLK & WESTERN RY.

The Norfolk & Western Ry. has installed several equilateral turnouts in high-speed territory: two at the ends of a short section of multiple track, six at locations where gauntlet track through tunnels was replaced with single track, and two others replacing ordinary turnouts at the end of multiple track.

In cases of installations replacing gauntlet track through tunnels, they were made primarily to increase the flexibility of operation rather than for maintenance economy. Maintenance costs at such locations are slightly higher, it being necessary to renew the switch points at 6-month intervals. The two installations at the ends of a short section of multiple track were made along with the second track installation so there is no basis for an economic comparison. The economics are, therefore, restricted to the two installations replacing ordinary turnouts.

Installation No. 1.

A No. 20 turnout has been replaced with a No. 20 equilateral turnout and authorized speed for freight trains increased from 15 to 35 miles per hour westward and reduced from 45 to 35 miles per hour eastward.

Saving per Year		
	Before installation	After installation
Track:		
Lining and gaging.....	416 man hours	96 man hours
Changing switch points.....	96 man hours	12 man hours
Material.....	4 switch points	1 switch point
Car time:		
Number of trains operated per month.....		835
Number of trains operated per year.....		10,020
Average cars per train.....		61
Total cars per year.....		611,220
Cars hours saved per year, 5 minutes per car.....		50,935
Car days saved per year.....		2,122
Engine time:		
Engine hours saved per year.....		835
Engine days saved per year.....		35
Locomotive fuel:		
Estimated coal saving.....		966 tons
Operating Saving		
		Annual saving
Maintenance labor—404 man hours @ \$1.40.....		\$ 565
Maintenance material—3 switch points @ \$400.....		1,200
Fuel—966 tons coal @ \$8.83.....		8,530
Total saving.....		\$10,295

Economic Statement

1. Cost of Installation:	
(a) Total.....	\$ 2,100
2. Gross Saving per Annum.....	\$10,295
3. Deduction for Interest Charges @ 4% (of 1-a).....	84
4. Net Saving per Annum.....	\$10,211
5. Annual Return over 4% Interest:	
(a) On Total Cost ($4 \div 1-a$).....	486%

Installation No. 2.

A No. 20 turnout has been replaced with a No. 20 equilateral turnout and authorized speed for freight trains increased from 15 to 35 miles per hour eastward and reduced from 45 to 35 miles per hour westward.

Saving per Year

	Before installation	After installation
Track:		
Lining and gaging.....	277 man hours	64 man hours
Changing switch points.....	24 man hours	6 man hours
Material.....	2 switch points	$\frac{1}{2}$ switch point
Car time:		
Number of trains operated per month.....	568	
Number of trains operated per year.....	6,816	
Average cars per train.....	38	
Total cars per year.....	259,008	
Car hours saved per year, 5 minutes per car.....	21,584	
Car days saved per year.....	899	
Engine time:		
Engine hours saved per year.....	568	
Engine days saved per year.....	24	
Locomotive fuel:		
Estimated coal saving.....	353 tons	

Operating Saving

	Annual saving
Maintenance labor—231 man hours @ \$1.40.....	\$ 323
Maintenance material— $1\frac{1}{2}$ switch points @ \$400....	600
Fuel—353 tons coal @ \$8.83.....	3,117
Total saving.....	\$4,040

Economic Statement

1. Cost of Installation:	
(a) Total.....	<u>\$1,200</u>
2. Gross Saving per Annum.....	<u>\$4,040</u>
3. Deduction for Interest Charges @ 4% (of 1-a).....	<u>48</u>
4. Net Saving per Annum.....	<u>\$3,992</u>
5. Annual Return over 4% Interest:	
(a) On Total Cost ($4 \div 1-a$).....	333%

Note:—The saving in car and locomotive time has been excluded from the economic calculations since it is only 5 minutes for each locomotive and each car.

Action Recommended

Acceptance as information.

**ECONOMICS OF CONTROLLED MANUAL BLOCK AND TRAIN
ORDER OPERATION ON 19.6 MILES OF SINGLE-TRACK MAIN
LINE OF THE CHICAGO & EASTERN ILLINOIS R. R.
BETWEEN FINDLAY JUNCTION AND PANA, ILL.**

The Chicago & Eastern Illinois R. R. installed, in October 1949, a controlled manual block system replacing a manual block system on 19.6 miles of single track between Findlay Junction and Pana, Ill. This section of the Railroad is on the Chicago to St. Louis main line between Woodland Junction and Pana, Ill. At Pana, connection is made to the New York Central System (C. C. & St. L. Ry.) where joint two-track operation is in service between Pana and St. Louis, Mo.

Trains were formerly directed by manual block and train orders from a continuous office at Findlay Junction interlocking, a day office at Westervelt, and a continuous office at Pana Station, about 700 feet north of Pana interlocking.

Trains operating in this territory in October 1949 consisted of four freight trains daily, as follows:

Direction	Train No.	Findlay Junction	Pana
Southward	65	4:09 a.m.	4:40 a.m.
Southward	61	5:10 p.m.	5:40 p.m.
Northward	62	3:39 p.m.	3:15 p.m.
Northward	64	12:23 a.m.	11:55 p.m.

(Passenger train operation had previously been discontinued)

Since that time a local extra train has been added which makes a trip one way between Findlay and Pana daily except Sunday.

The trains are so spaced that unless considerably off schedule they will not meet in this territory. The through trains average about 80-85 cars in length.

Formerly, several passenger trains and freight trains were operated in each direction daily in this territory, but with the reduced number of trains and the increased cost of governing train movements by manual block, studies were made to determine an economical arrangement with increased safety.

Operation by signal indication and automatic block signals, while desirable, would have involved greater first cost than a system of controlled manual block operation.

The final installation consists of a controlled manual block as shown in Fig. 1, with train order operation, with one block for the 19.6 mile territory, and consists of the following:

Manual block signals Nos. 1 and 2 located at Findlay Junction and Pana, both controlled from Findlay Junction. The location at Pana provides for future extension of 60 car siding if required.

Addition of an automatic dwarf signal for northward trains near the Pana Station to provide automatic block protection from the interlocking to the controlled manual block signal No. 2.

Relocation of the southward approach signal at Pana and the northward approach signal at Findlay Junction. These signals were moved to interconnect properly with the controlled manual block system.

Continuous track circuits of the non-coded type.

Adding of switch circuit controllers to hand-operated switches that were not equipped.

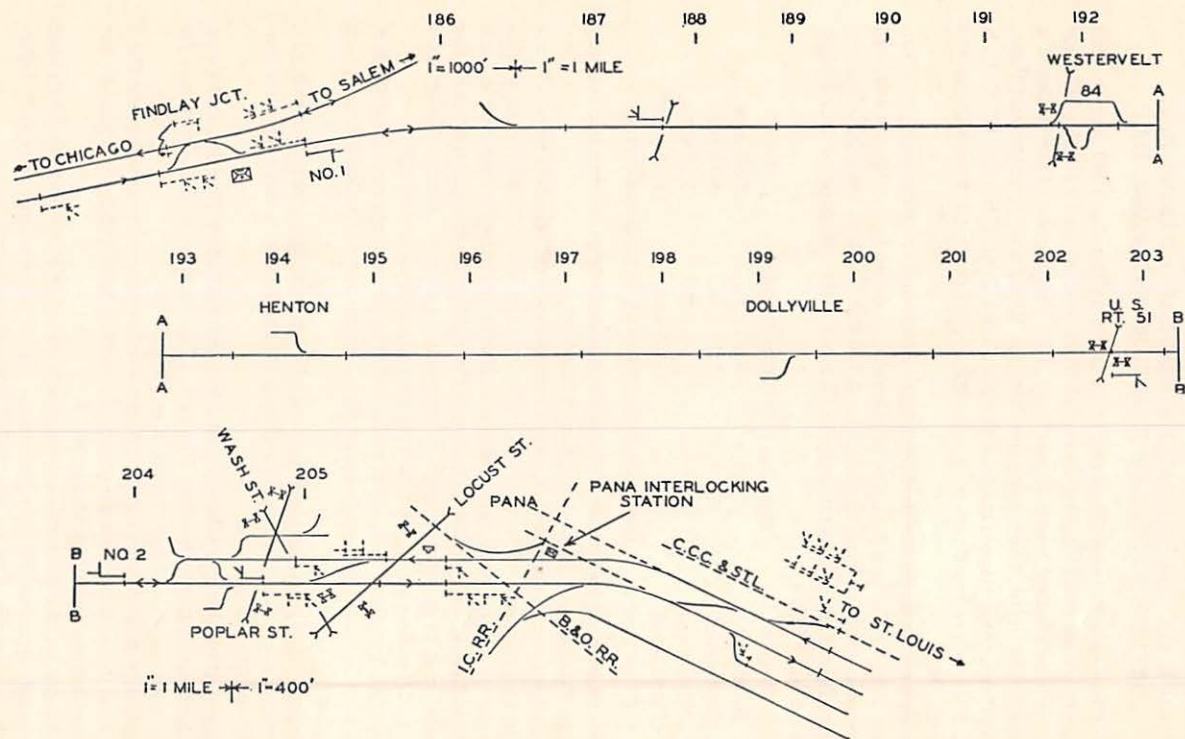


Fig. 1.
Chicago & Eastern Illinois R. R.
Findlay Junction to Pana, Ill.

The use of continuous track circuits provides broken rail and switch protection in addition to block protection and increases the safety of train operation as compared to the previous method of directing trains.

In case a meet or pass is required at Westervelt, train orders will be issued at Findlay Junction or Nakomis on the New York Central System. Train movement from Pana or Findlay Junction will be by block signal protection to the siding. As soon as the train is in the clear at Westervelt siding and reports clear, the block signal at either end can be cleared for another train. As absolute block protection is provided for either a northward or southward train, only one train can be in the block at a time.

Economic Statement

1. Cost of Installation:	
(a) Capital Investment.....	\$19,875
(b) Operating Expenses.....	486
(c) Salvage.....	421
(d) Total.....	<u>\$20,782</u>
2. Gross Saving per Annum.....	\$11,849
3. Increased Annual Operating Expenses.....	970
4. Net Reduction in Annual Operating Expenses.....	<u>\$10,879</u>
5. Deduction for Interest Charges @ 3% (of 1-a).....	596
6. Net Saving per Annum.....	<u>\$10,283</u>
7. Annual Return over 3% Interest:	
(a) On Capital Investment ($6 \div 1-a$).....	51.7%
(b) On Total Cost ($6 \div 1-d$).....	49.5%

Summary of Advantages

1. Provided an economical signal system for handling train movements on a light traffic line at a cost of about \$1,060 per mile.

2. Reduced annual operating expenses \$10,879 per year, such saving being made possible by the elimination of two operator positions and reduced working time on a third position.

3. Showed an estimated return on capital investment, over interest, of 51.7 per cent per year.

4. Increased the safety of train operation by installing an absolute block with continuous track circuits and switch protection.

5. The signal facilities provide capacity to meet sudden demands for increased traffic during emergencies.

Action Recommended

Acceptance as information.

TRAIN HOUR VALUE

At the 1951 Annual Meeting* the Committee submitted a full report on train hour value, including Table II covering Year 1949. A revision of Table II for the Year 1950 which brings the information up-to-date with the latest available figures, is presented herein. It will be noted in the Table, that the total train hour cost (excluding train crew wages) as shown in Column 5 for most of the railroads is less than the costs were for 1949; however, the composite average for the 78 railroads amounts to a reduction of only 15 cents per hour, decreasing from 33.59 for 1949 as compared to 33.44 for 1950.

TABLE II
Specified Elements of Train Hour Cost
per Road Freight Train Hour—Year 1950
(Excluding road freight train crews' wages)

Railroad	Elements of train hour cost (per road freight train hour)			
	Fuel, supplies, enginehouse expense and locomotive repairs	Road freight locomotive depreciation	Payroll taxes on labor applicable to road freight locomotive repairs and enginehouse expense a	Total train hour cost (excluding train crew wages)
1	2	3	4	5=2+3+4
Item number in report	Items 2 to 8	Item 9	Item 11	Items 2 to 11
NEW ENGLAND REGION:				
1 Bangor & Aroostook.....	\$18.70	\$4.72	\$0.30	\$23.72
2 Boston & Maine.....	23.63	1.40	0.50	25.53
3 Central Vermont.....	26.95	0.06	0.43	27.44
4 Maine Central.....	19.26	1.40	0.38	21.04
5 New York, New Haven & Hartford.....	29.83	2.23	0.60	32.66
6 Rutland.....	27.02	0.66	0.44	29.02
GREAT LAKES REGION:				
7 Grand Trunk Western.....	30.26	1.62	0.43	32.31
8 Erie (Incl. Chgo. & Erie).....	30.86	1.52	0.60	32.98
9 New York, Chgo. & St. Louis (Incl. W. & L.E.).....	32.55	0.90	0.58	34.03
10 Delaware & Hudson.....	55.18	3.16	1.18	59.52
11 Delaware, Lackawanna & Western.....	26.65	3.30	0.43	30.38
12 Lehigh & New England.....	11.01	7.01	0.15	18.17
13 Lehigh Valley.....	33.48	4.32	0.55	38.35
14 Monongahela.....	20.90	1.12	0.40	22.42
15 New York, Ontario & Western.....	15.04	3.67	0.36	19.07
16 New York Central (Incl. B. & A.).....	33.86	1.89	0.64	36.39
17 Pittsburgh & Lake Erie.....	44.66	1.49	0.68	46.83
18 Ann Arbor.....	22.04	0.52	0.38	22.94
19 Wabash.....	32.08	2.40	0.49	34.97
CENTRAL EASTERN REGION:				
20 Baltimore & Ohio.....	32.83	1.26	0.71	34.80
21 Bessemer & Lake Erie.....	85.13	4.18	2.20	91.51
22 Chicago & Eastern Illinois.....	21.79	2.95	0.35	25.09
23 Chicago, Indianapolis & Louisville.....	24.44	3.04	0.47	27.95
24 Detroit, Toledo & Ironton.....	25.98	1.31	0.39	27.68
25 Elgin, Joliet & Eastern.....	12.82	2.00	0.26	15.08
26 Illinois Terminal.....	10.30	1.00	0.16	11.46
27 Long Island.....	13.92	1.08	0.25	15.25
28 Pennsylvania.....	36.44	2.35	0.73	39.52
29 Cent. RR of New Jersey (Incl. C.R.R. of Pa.).....	35.14	2.75	0.69	38.58
30 Reading.....	30.28	1.83	0.60	32.71
31 Western Maryland.....	41.95	3.36	0.92	46.23
POCAHONTAS REGION:				
32 Chesapeake & Ohio (Incl. Pere M.).....	35.01	2.57	0.66	38.24
33 Norfolk & Western.....	43.72	2.05	0.79	46.56
34 Richmond, Fred'burg & Potomac.....	29.32	3.94	0.40	33.66
35 Virginian.....	32.78	3.76	0.69	37.23

a Payroll taxes calculated at rate of 5.75 per cent. Reduction from actual rate of 6.50 per cent account compensation in excess of \$300 per month.

*A.A.R. Signal Section 1950 Proceedings, Vol. XLVIII, pp. 38 and 390.

TABLE II—Continued

Railroad	Elements of train hour cost (per road freight train hour)			
	Fuel, supplies, enginehouse expense and locomotive repairs	Road freight locomotive depreciation	Payroll taxes on labor applicable to road freight locomotive repairs and enginehouse expense ^a	Total train hour cost (excluding train crew wages)
1	2	3	4	5=2+3+4
Item number in report	Items 2 to 8	Item 9	Item 11	Items 2 to 11
SOUTHERN REGION:				
36 Atlantic Coast Line.....	\$22.07	\$1.56	\$0.36	\$23.99
37 Clinchfield.....	35.06	3.11	0.70	38.87
38 Louisville & Nashville.....	27.15	0.97	0.50	28.62
39 Nashville, Chattanooga & St. Louis.....	19.56	2.39	0.29	22.24
40 Florida East Coast.....	22.12	3.44	0.36	25.92
41 Gulf, Mobile & Ohio (Incl. Alton).....	30.39	5.91	0.66	36.96
42 Central of Georgia.....	25.82	1.01	0.48	27.31
43 Illinois Central (Incl. Y. & M. V.).....	29.21	1.07	0.54	30.82
44 Norfolk Southern.....	17.53	2.00	0.41	19.94
45 Seaboard Air Line.....	26.15	2.37	0.47	28.99
46 Alabama Great Southern.....	33.21	3.84	0.67	37.72
47 Cincinnati, New Orleans & Tex. Pac.....	35.05	3.62	0.72	39.39
48 Southern.....	25.86	3.49	0.56	29.91
NORTHWESTERN REGION:				
49 Soo Line (Incl. Wis. C.).....	26.59	1.22	0.46	28.27
50 Chicago & North Western.....	13.15	2.81	0.35	16.31
51 Chicago, St. Paul, Minneapolis & Omaha.....	21.10	0.97	0.25	22.32
52 Chicago Great Western.....	20.29	4.82	0.27	25.38
53 Chicago, Milwaukee, St. Paul & Pac.....	27.60	1.65	0.44	29.69
54 Duluth, Missabe & Iron Range.....	57.47	0.57	1.08	59.12
55 Great Northern.....	28.06	1.49	0.50	30.05
56 Minneapolis & St. Louis.....	16.70	2.57	0.34	19.61
57 Northern Pacific.....	31.43	1.85	0.62	33.90
58 Spokane, Portland & Seattle.....	20.53	2.44	0.37	23.34
CENTRAL WESTERN REGION:				
59 Atchison, Topeka & Santa Fe.....	30.45	2.03	0.58	33.06
60 Chicago, Burlington & Quincy.....	24.98	1.95	0.35	27.28
61 Colorado & Southern.....	29.97	1.17	0.49	31.63
62 Fort Worth & Denver.....	22.98	0.94	0.35	24.27
63 Denver & Rio Grande W. (Incl. D. & S. L.).....	39.53	3.29	0.78	43.60
64 Rock Island System.....	24.32	1.27	0.40	25.99
65 Northwestern Pacific.....	14.05	0.45	0.25	14.75
66 Southern Pacific.....	35.74	2.60	0.80	39.14
67 Union Pacific.....	45.45	2.87	0.78	49.10
68 Western Pacific.....	32.86	3.91	0.61	37.38
SOUTHWESTERN REGION:				
69 Frisco Lines.....	23.14	2.78	0.39	26.31
70 Kansas City Southern.....	33.16	3.28	0.59	37.03
71 Louisiana & Arkansas.....	26.49	1.89	0.45	28.83
72 Missouri-Kansas-Texas.....	22.49	2.27	0.39	25.15
73 Gulf Coast Lines.....	23.87	1.97	0.50	26.34
74 International-Great Northern.....	26.01	2.62	0.56	29.19
75 Missouri Pacific.....	27.78	2.34	0.51	30.63
76 Texas & Pacific.....	29.50	2.70	0.47	32.67
77 St. Louis Southwestern.....	26.18	1.49	0.46	28.13
78 Texas & New Orleans.....	30.40	0.80	0.60	31.80
Composite Average.....	30.76	2.10	0.58	33.44
AVERAGES BY REGIONS:				
New England.....	25.42	1.76	0.50	27.68
Great Lakes.....	33.17	1.99	0.60	35.76
Central Eastern.....	33.74	2.00	0.69	36.43
Poconos.....	37.33	2.52	0.70	40.55
Southern.....	26.70	2.10	0.50	29.30
Northwestern.....	25.34	1.90	0.46	27.70
Central Western.....	33.62	2.30	0.63	36.55
Southwestern.....	26.90	2.12	0.49	29.51

^a Payroll taxes calculated at rate of 5.75 per cent. Reduction from actual rate of 6.50 per cent account compensation in excess of \$300 per month.

Action Recommended
Acceptance as information.

TRACK AND ROADWAY MAINTENANCE EXPENSES— PER EQUATED TRACK MILE

At the 1951 Annual Meeting* the Committee submitted a report on this assignment and presented Table I for the Calendar Year 1949. A revision of Table I for the Calendar Year 1950, which brings the information up-to-date with the latest available figures, is presented herein. As shown in Table I, track and roadway maintenance expenses per equated track mile for the year 1950 varied from a minimum of \$476 to a maximum of \$6,291, with a composite average of \$2,317 for the 78 railroads.

TABLE I
Track and Roadway Maintenance Expenses per Equated
Track Mile (Running Tracks) and Traffic Density
Calendar Year 1950

Railroad	Equated track miles (running tracks) a	Track and roadway maintenance expenses		Gross ton-miles per mile of road (traffic density) d (000)
		Total b	Per equated track mile c	
NEW ENGLAND REGION:				
1 Bangor & Aroostook.....	660.70	\$1,482,134	\$2,243	2,418
2 Boston & Maine.....	2,210.60	4,818,044	2,180	6,857
3 Central Vermont.....	394.72	924,037	2,341	4,618
4 Maine Central.....	1,068.70	2,392,368	2,239	3,215
5 New York, New Haven & Hartford.....	2,459.86	5,824,710	2,368	9,398
6 Rutland.....	437.81	327,238	747	2,497
GREAT LAKES REGION:				
7 Grand Trunk Western.....	1,294.84	4,070,258	3,143	9,671
8 Erie (Incl. Chgo. & Erie).....	3,363.35	9,482,084	2,819	13,749
9 New York, Chgo. & St. Louis (Incl. W.&L.E.).....	2,606.54	8,276,518	3,175	12,753
10 Delaware & Hudson.....	998.24	3,594,885	3,601	13,686
11 Delaware, Lackawanna & Western.....	1,529.74	3,974,716	2,598	13,306
12 Lehigh & New England.....	183.89	493,044	2,681	4,179
13 Lehigh Valley.....	1,752.87	3,701,165	2,111	9,401
14 Monongahela.....	207.02	401,623	1,940	6,010
15 New York, Ontario & Western.....	524.26	639,281	1,219	2,494
16 New York Central (Incl. B. & A.).....	14,992.90	34,317,907	2,289	12,826
17 Pittsburgh & Lake Erie.....	375.37	2,361,359	6,291	18,242
18 Ann Arbor.....	320.60	602,239	1,878	5,563
19 Wabash.....	2,555.05	6,131,885	2,400	8,984
CENTRAL EASTERN REGION:				
20 Baltimore & Ohio.....	7,898.92	27,408,260	3,470	12,458
21 Bessemer & Lake Erie.....	333.67	1,257,939	3,770	16,348
22 Chicago & Eastern Illinois.....	967.29	1,195,798	1,236	6,046
23 Chicago, Indianapolis & Louisville.....	567.60	1,640,992	2,891	5,688
24 Detroit, Toledo & Ironton.....	477.16	1,190,824	2,496	4,611
25 Elgin, Joliet & Eastern.....	279.67	1,271,726	4,547	14,914
26 Illinois Terminal.....	515.18	754,609	1,465	2,361
27 Long Island.....	579.32	275,679	476	8,815
28 Pennsylvania.....	14,847.76	43,628,309	2,938	15,797
29 Cent.R.R. of New Jersey (Incl.C.R.R. of Pa.).....	838.36	2,875,154	3,429	10,798
30 Reading.....	2,152.72	7,024,801	3,263	12,005
31 Western Maryland.....	877.40	3,028,313	3,451	8,455
POCAHONTAS REGION:				
32 Chesapeake & Ohio (Incl. Pere M.).....	5,739.90	21,923,234	3,819	13,622
33 Norfolk & Western.....	2,967.29	12,128,641	4,087	18,188
34 Richmond, Fred'burg & Potomac.....	238.69	969,410	4,061	34,949
35 Virginian.....	719.08	1,856,271	2,581	10,752

a Based on a weight of 100 for first main track, 80 for additional main track, passing tracks, crossovers, and turnouts operated; mileage operated under trackage rights is excluded.

b Includes charges for maintenance of running tracks to Operating Expense Accounts 202, 208, 212, 214, 216, 218, 220, and total charges to Accounts 269, 270, 271, 272 and 274.

c Represents equivalent expense for one mile of first main track. Expense per mile of additional main track, passing tracks, crossovers, and turnouts may be computed as 80 per cent of this amount.

d Represents gross ton-miles (including locomotive and tender) freight and passenger service per mile of first main track.

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Com. I—Economics of Ry. Signaling

TABLE I—Continued

Railroad	Equated track miles (running tracks) a	Track and roadway maintenance expenses		Gross ton-miles per mile of road (traffic density) d (000)
		Total b	Per equated track mile c	
SOUTHERN REGION:				
36 Atlantic Coast Line.....	6,257.76	\$12,604,696	\$2,014	5,533
37 Clinchfield.....	328.76	1,962,187	5,968	12,343
38 Louisville & Nashville.....	5,620.28	11,886,222	2,115	8,767
39 Nashville, Chattanooga & St. Louis.....	1,205.85	3,228,648	2,677	6,474
40 Florida East Coast.....	945.67	2,068,684	2,188	8,690
41 Gulf, Mobile & Ohio (Incl. Alton).....	3,016.90	6,190,083	2,052	5,148
42 Central of Georgia.....	1,925.10	3,272,196	1,700	4,655
43 Illinois Central (Incl. Y. & M. V.).....	7,908.85	20,911,305	2,644	8,855
44 Norfolk Southern.....	701.59	1,370,564	1,954	2,315
45 Seaboard Air Line.....	4,643.58	10,941,098	2,356	6,847
46 Alabama Great Southern.....	400.63	1,209,601	3,019	12,188
47 Cincinnati, New Orleans & Tex. Pac.	584.08	2,757,882	4,722	25,116
48 Southern.....	7,044.06	15,355,387	2,180	6,828
NORTH WESTERN REGION:				
49 Soo Line (Incl. Wis. C.).....	4,360.83	6,701,258	1,537	3,660
50 Chicago & North Western.....	9,025.50	12,941,778	1,434	4,925
51 Chicago, St. Paul, Minneapolis & Omaha.....	1,811.70	2,505,869	1,383	4,066
52 Chicago Great Western.....	1,523.07	4,866,566	3,195	5,335
53 Chicago, Milwaukee, St. Paul & Pacific.....	11,428.58	14,388,495	1,259	4,923
54 Duluth, Missabe & Iron Range.....	746.99	2,979,477	3,989	12,211
55 Great Northern.....	8,853.69	19,553,823	2,209	5,650
56 Minneapolis & St. Louis.....	1,364.44	2,139,086	1,568	2,593
57 Northern Pacific.....	7,721.26	12,278,768	1,590	5,178
58 Spokane, Portland & Seattle.....	965.25	3,821,154	3,959	5,778
CENTRAL WESTERN REGION:				
59 Atchison, Topeka & Santa Fe.....	15,793.21	33,139,469	2,098	9,193
60 Chicago, Burlington & Quincy.....	9,763.83	16,230,552	1,662	6,061
61 Colorado & Southern.....	653.68	731,230	1,119	4,042
62 Fort Worth & Denver.....	1,076.68	1,341,129	1,246	3,537
63 Denver & Rio Grande W. (Incl. D. & S.L.).....	2,651.49	3,936,701	1,485	5,930
64 Rock Island System.....	8,124.41	10,755,693	1,324	5,256
65 Northwestern Pacific.....	369.21	1,356,225	3,673	4,902
66 Southern Pacific.....	9,486.06	25,245,561	2,661	12,727
67 Union Pacific.....	11,529.94	31,264,981	2,712	11,665
68 Western Pacific.....	1,263.32	3,852,955	3,050	8,712
SOUTHWESTERN REGION:				
69 Frisco Lines.....	5,287.24	10,025,794	1,896	5,251
70 Kansas City Southern.....	988.11	2,159,423	2,185	9,815
71 Louisiana & Arkansas.....	705.40	2,038,703	2,890	5,148
72 Missouri-Kansas-Texas.....	3,348.58	5,386,011	1,608	4,932
73 Gulf Coast Lines.....	1,246.64	3,241,770	2,600	4,976
74 International-Great Northern.....	1,130.22	3,373,418	2,985	6,601
75 Missouri Pacific.....	7,548.86	19,587,028	2,595	7,033
76 Texas & Pacific.....	2,076.64	4,970,661	2,394	8,315
77 St. Louis Southwestern.....	1,542.78	3,999,351	2,592	8,008
78 Texas & New Orleans.....	4,635.12	11,303,674	2,439	6,629
Composite Average.....	255,542.91	592,120,581	2,317	8,373
AVERAGES BY REGIONS:				
New England.....	7,232.39	15,768,531	2,180	6,111
Great Lakes.....	30,704.67	78,046,964	2,542	11,841
Central Eastern.....	30,335.05	91,552,374	3,018	12,963
Poconos.....	9,664.96	36,877,556	3,816	14,918
Southern.....	40,583.11	93,758,553	2,310	7,229
Northwestern.....	47,801.31	82,176,274	1,719	4,999
Central Western.....	60,711.83	127,854,496	2,106	8,726
Southwestern.....	28,509.59	66,085,833	2,318	6,464

a Based on a weight of 100 for first main track, 80 for additional main track, passing tracks, crossovers, and turnouts operated; mileage operated under trackage rights is excluded.

b Includes charges for maintenance of running tracks to Operating Expense Accounts 202, 208, 212, 214, 216, 218, 220, and total charges to Accounts 269, 270, 271, 272 and 274.

c Represents equivalent expense for one mile of first main track. Expense per mile of additional main track, passing tracks, crossovers, and turnouts may be computed as 80 per cent of this amount.

d Represents gross ton-miles (including locomotive and tender) freight and passenger service per mile of first main track.

Action Recommended
Acceptance as information.

ECONOMICS OF NEW YARD FACILITIES ON THE UNION PACIFIC R.R. AT NORTH PLATTE, NEBR., INCLUDING CAR RETARDER CLASSIFICATION YARD*

A system study of the traffic flow and terminal operations on the Union Pacific R.R. indicated the practicability of providing new terminal facilities at North Platte, Nebr., which is 284 miles west of the Road's eastern terminus at Council Bluffs, Iowa. Also, it is the first terminal beyond the junction to Kansas City, and a logical point for breaking up and assembling traffic moving through the Council Bluffs and Kansas City gateways.

The new yard facilities consist primarily of a 42-track car retarder classification yard, a 12-track receiving yard and the rearrangement of existing trackage to provide departure facilities; also complete yard and locomotive communications and interlocking for movement of trains to and from the main tracks at the east end, as well as car inspection and journal box hot-oiling facilities on the approach to the classification yard. The classification yard is illustrated in Fig. 1.

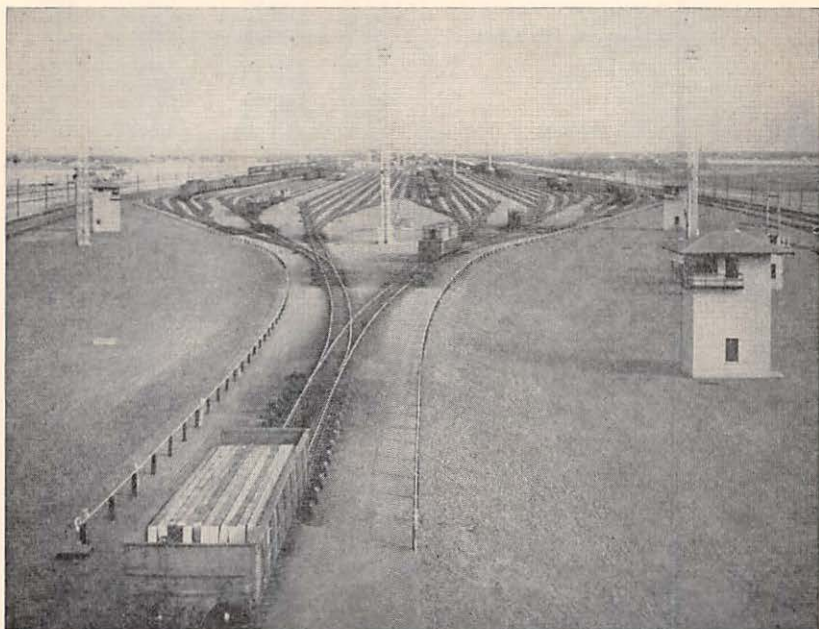


Fig. 1.

The North Platte improvements were provided for the purpose of concentrating the classification of through traffic at this terminal and to eliminate duplicate switching at other points.

* Previous report on this subject appears in A.A.R. Signal Section 1949 Proceedings, Vol. XLVII, pp. 22 and 319.

Operation of the new yard and associated facilities began on September 1, 1948. It is now the practice to completely classify all eastward and a substantial part of the westward traffic at North Platte. This change of operation has contributed to an increased freight train load by making cars available for earlier movement with resulting reduction in freight trains and freight train miles. Movement of freight traffic has been expedited resulting in a substantial saving in freight car days.

A comparison of the operations has been made for the year 1947 (before) and 1949 (after), to determine the economic benefits derived from the investment.

Following is a tabulation of cars classified through the retarder yard for a period of 12 months ending with February 1950:

Cars classified at North Platte

Month	Eastward	Westward	Total	Daily average	Peak day
Mar. 1949	37,580	18,023	55,603	1,794	2,104
Apr. 1949	36,365	19,422	55,787	1,860	2,251
May 1949	43,707	27,494	71,201	2,297	2,922
June 1949	37,642	29,133	66,775	2,226	2,868
July 1949	47,040	31,813	78,853	2,544	3,017
Aug. 1949	53,557	28,705	82,262	2,654	2,992
Sept. 1949	55,574	26,847	82,421	2,747	3,094
Oct. 1949	57,659	27,925	85,584	2,761	3,077
Nov. 1949	49,978	31,612	81,590	2,720	3,563
Dec. 1949	43,309	22,551	65,860	2,125	2,869
Jan. 1950	40,279	23,706	63,985	2,064	2,505
Feb. 1950	33,494	22,589	56,083	2,003	2,458

The economic benefits derived include:

- (a) Reduction in switch engine hours, including overtime hours, at many terminals.
- (b) Reduced freight trains and freight train miles.
- (c) Reduced freight car days.
- (d) Reduced damage to equipment and lading.
- (e) Reduced personal injuries.
- (f) Reduced switch engine requirements resulted in saving the investment in nine Diesel switchers under the Road's dieselization program.

The gross saving per annum based on comparison of the 1947 and 1949 operations and equated to place the 2 years on the comparable cost basis, amounted to \$1,676,131. After allowing \$335,973 for cost of operation, maintenance and depreciation of the new plant, a net annual saving of \$1,340,158 was effected.

The cost of the new terminal facilities including all trackage, grading, drainage and other facilities previously mentioned, amounted to \$3,183,000.

Economic Statement

1. Cost of Installation:	
(a) Capital Investment.....	\$2,511,000
(b) Operating Expenses.....	630,000
(c) Accrued Depreciation.....	3,000
(d) Salvage.....	39,000
(e) Total.....	<u>\$3,183,000</u>
2. Gross Saving per Annum.....	<u>\$1,676,131</u>
3. Increased Annual Operating Expenses.....	<u>335,973</u>
4. Net Reduction in Annual Operating Expenses.....	<u>\$1,340,158</u>
5. Deduction for Interest Charges @ 5% (of 1-a).....	<u>125,550</u>
6. Net Saving per Annum.....	<u>\$1,214,608</u>
7. Annual Return over 5% Interest:	
(a) On Capital Investment ($6 \div 1-a$).....	48.4%
(b) On Total Cost ($6 \div 1-e$).....	38.2%

Action Recommended

Acceptance as information.

ECONOMICS OF CENTRALIZED TRAFFIC CONTROL VERSUS MULTIPLE TRACK POSTPONING ADDITIONAL MAIN TRACKS*

The advent of centralized traffic control about 25 years ago represented a major step as an economical means of increasing main track capacity.

Where the capacity saturation point had been reached, whether in single or multiple-track territory, centralized traffic control has offered an economical and quick means of providing necessary relief. The cost of centralized traffic control is only a fraction of the cost of providing additional main trackage; in one case, the cost of providing a second main track would have been 10 times the cost of the centralized traffic control installation adopted, and which has continued to provide ample capacity for peak train movements.

While the use of centralized traffic control as an alternate for additional main track goes back to its early days, it was not until World War II that full advantage was taken of this means of quickly providing increased capacity, at a time when the traffic volume far exceeded previous peak periods of the 1920's.

A review of centralized traffic control installations shows that more than 2,085 track miles of railroad have been equipped in this manner to provide necessary increase in main track capacity, rather than the more expensive and slower method of constructing additional trackage. The construction of approximately 1,600 miles of second main track was avoided.

Summary of Advantages

1. Lower first cost, representing only a fraction of the cost of constructing additional main trackage.
2. Confining work to existing right-of-way. In some cases additional right-of-way would be required and in a few instances an entirely new location would be necessary for additional trackage.
3. Relief could be provided in much less time.
4. Substantially lower maintenance of signal system as compared with maintenance of track and bridges.
5. Provides a system of trackage and signaling on an economical basis to meet the peaks and valleys of traffic volume.
6. Substantially reduced the amount of critical materials required, an important measure during World War II and in the present preparedness effort.

Action Recommended

Acceptance as information.

* Previous report on this subject appears in A.A.R. Signal Section 1948 Proceedings, Vol. XLVI, pp. 17 and 506.

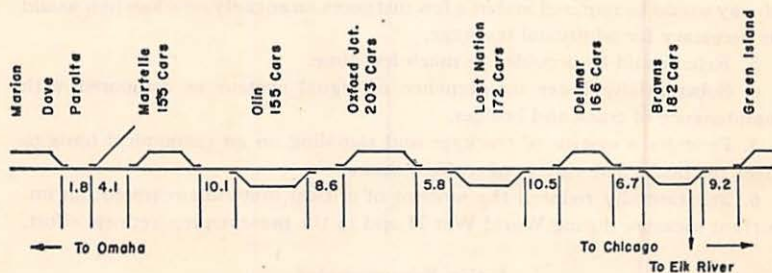
ECONOMICS OF SINGLE MAIN TRACK WITH CENTRALIZED TRAFFIC CONTROL REPLACING TWO MAIN TRACK OPERATION BETWEEN GREEN ISLAND AND MARION, IOWA ON THE CHICAGO, MILWAUKEE, ST. PAUL & PACIFIC R.R.*

The Chicago, Milwaukee, St. Paul & Pacific R.R. in 1950 removed the second main track for a distance of 67 miles between Green Island and Marion, Iowa, and installed centralized traffic control on the remaining track, including power-operated sidings advantageously located for meeting and passing trains.

A radical change in traffic conditions over the years suggested the economic feasibility of eliminating the second main track on a portion of the Milwaukee's route between Chicago, Ill. and Omaha, Nebr. and Sioux City, Iowa. When the second main was provided about 40 years ago a considerable number of freight trains were operated, including many short trains handling livestock. Heavier power has reduced the number of train movements and increased train speeds have cut the running time, bringing about a new pattern of train operation. Traffic averages 4 passenger and 10 freight trains daily between Green Island and Paralta, with 2 additional branch trains on weekdays between Paralta and Marion.

The line traverses a rolling country and has an undulating grade with maximum of 0.5 per cent except for one 4-mile stretch of 0.66 per cent eastward and other short stretches ranging up to 0.75 per cent. Curvature is relatively light.

The line being located in a highly competitive territory, service is of paramount importance, so it was decided to provide centralized traffic control on the single track with sidings so spaced as to hold train delays to a minimum. The track arrangement is as follows:



The importance of this project was emphasized by the condition of the rail in the westward main. The rail, largely 100-pound, laid in 1926, was in such condition that immediate renewal would be required if the two main track operation was to be continued. The rail renewal and other incidental work would have involved an expenditure of approximately 1.5 million dollars.

* *Railway Signaling and Communications*, April 1951, p. 233.

Previous report on this subject appears in A.A.R. Signal Section 1949 Proceedings, Vol. XLVII, pp. 28 and 319.

Economic Statement

1. Cost of Installation:		
(a) Capital Investment.....	\$ 374,689	
(b) Operating Expenses.....	168,356	
(c) Total.....		\$ 543,045
2. Retirements:		
(a) Signal Facilities.....	\$ 74,393	
(b) Track Facilities.....	1,697,762	
(c) Total.....		\$1,772,155
3. Annual Operating Expense Saving:		
(a) Signal Maintenance.....	\$ 1,500	
(b) Track Maintenance.....	96,496	
(c) Directing Train Movements.....	4,200	
(d) Total.....		\$ 102,196
4. Annual Return on Cost of New Work:		
(a) On Capital Investment (3-d ÷ 1-a).....		27.3%
(b) On Total Cost (3-d ÷ 1-c).....		18.8%

Summary of Advantages

1. 55.56 miles of second main track abandoned.
2. 1.45 miles of siding abandoned.
3. 10.25 miles of second main converted to siding.
4. Saved signal maintenance.
5. Saved track and bridge maintenance.
6. Reduced cost of directing train movements.
7. Provided modern signal system.
8. Increased safety of train movements.

Action Recommended

Acceptance as information.

**ECONOMICS OF THE CONVERSION OF SECOND MAIN TRACK TO
A YARD TRACK AND THE INSTALLATION OF REMOTE CONTROL
WITH TRAIN OPERATION BY SIGNAL INDICATION ON THE
SOUTHERN RY. AT INMAN YARDS, ATLANTA, GA.**

In 1950, the Southern Ry.* converted 4.5 miles of second main track to a yard track in connection with a general revision of Inman Yards, Atlanta, Ga. A remotely controlled signal system, with interlocked connections to the yard at three locations, was installed on the remaining single track.

An additional freight track was needed in connection with the expansion of the yard. However, because of the congested area, overhead bridge, structures and expensive right-of-way, it was decided to give up the second main track through the limits of the yard and operate trains by signal indication. This eliminated the necessity of constructing 4.5 miles of track. A total of 12 scheduled passenger trains move through the territory involved each day. Also, freight trains and yard cuts use a part of the main track on each end in order to enter or leave the yard.

The remote control system also made it possible to release six switch tenders for duty at other locations, with resultant saving in operating expenses as follows:

Operating Saving

(a) The necessity of constructing 4.5 miles of additional track at a cost of \$398,300 was avoided. The annual interest charges on this expenditure at 3 per cent would have amounted to.....	\$11,949
(b) The maintenance of 4.5 miles of second track was saved with annual saving in the amount of.....	8,100
(c) Six switch tenders were released for duty at other locations. The annual wages for these men, together with payroll tax and vacation relief, amounted to.....	29,452
Total annual saving.....	<u>\$49,501</u>

* *Railway Signaling*, Oct. 1950, pp. 620, 621 and 628.

Economic Statement

1. Cost of Installation:		
(a) Capital Investment.....	\$107,604	
(b) Operating Expenses.....	450	
(c) Total.....		<u>\$108,054</u>
2. Gross Saving per Annum.....		
		\$ 49,501
3. Increased Annual Operating Expenses.....		
		<u>9,300</u>
4. Net Reduction in Annual Operating Expenses.....		
		\$ 40,201
5. Deduction for Interest Charges @ 3% (of 1-a).....		
		<u>3,228</u>
6. Net Saving per Annum.....		
		<u>\$ 36,973</u>
7. Annual Return over 3% Interest:		
(a) On Capital Investment ($6 \div 1-a$).....		34%

Action Recommended

Acceptance as information.

ECONOMICS OF "OFF TRACK" EQUIPMENT*

Highway vehicles used by the signal department.

A Southwestern road reporting use of automobiles and trucks by signal department forces submits the following data for the year 1951 covering equipment used by supervisory and maintenance forces:

Assigned to	Type of vehicle	Miles assigned territory	Annual cost of operation**	Average monthly mileage	Average cost per mile
Sig. Engr.	Sedan	928	\$1,948.89	3,074	\$0.053
Const. Supvr.	½-ton pick-up	928	1,624.40	3,356	0.040
Gen. Inspr.	Suburban Carryall	928	975.88	2,036	0.039
Asst. Const. Supvr.	½-ton pick-up	928	1,908.05	3,429	0.046
Supvr.	½-ton pick-up	321	980.31	1,750	0.047
Asst. Supvr.	½-ton pick-up	182	1,005.23	1,784	0.047
Asst. Supvr.	½-ton pick-up	139	1,221.63	2,094	0.049
Maintr.	½-ton pick-up	34	690.37	1,234	0.047
Supvr.	½-ton pick-up	607	1,915.50	4,753	0.064
Average.....		555	\$1,363.36	2,613	\$0.048

They also submit the following data on trucks used by construction forces:

Gang No. 1	2-ton stake body	Various	\$1,238.13	781	\$0.132
Gang No. 3	2-ton pick-up	Various	1,240.33	804	0.140
Gang No. 4	1-ton pick-up	Various	1,025.07	789	0.110
Gang No. 5	2-ton pick-up	Various	1,562.79	887	0.160
Gang No. 6	1½-ton stake body	Various	1,173.49	1,108	0.096
Gang No. 7	2-ton stake body	Various	1,934.51	943	0.171
Average.....			\$1,362.39	885	\$0.135

* Previous report on this subject appears in A.A.R. Signal Section 1950 Proceedings, Vol. XLVIII, pp. 29 and 389.

** Includes gas, oil, garage rent, tolls, replacements, repairs, licenses, depreciation and insurance.

Post hole diggers.

A Western railroad reports the use of three types of post hole diggers or earth borers:

Type 1 consists of the boring machine mounted on the rear of a truck, the power source of the boring machine being a four cylinder gasoline engine which is part of the complete boring device.

Type 2 is a small machine assembled as a trailer which may be operated over highways behind a car or truck, although the trailer assembly is also self-propelled but at a very slow speed, approximately 6 to 8 miles per hour, for moving around the area where the hole digging is to be done. The power source of the digger is a small 6 horsepower gasoline engine as is the power source for the self-propulsion.

Type 3 consists of a caterpillar tractor to which the boring auger is mounted on the rear of the tractor, the power being supplied to the boring attachment by power take-off from the tractor engine.

On Types 1 and 3 the "earth borer" consists of an auger attached to a shaft which can be rotated at slow or high speeds, slow for digging and high for throwing the earth away from the hole when the auger is raised from time to time to scour the hole. The shaft is from 10 to 20 feet in length and is enclosed in a hollow boom, the rotating shaft being lowered or raised during the digging operation.

Two levers control the digging operation, one for controlling the speeds of the auger, the other to raise or lower the auger shaft.

On Type 2 the boring device is similar to the small hand type post hole digger which is rotated in the earth until the blades are full, then withdrawn and emptied after which the digger is again lowered in the hole and the process repeated until the hole is completed.

On Types 1 and 3 the hollow boom enclosing the auger shaft may be adjusted to various angles to permit digging with the tractor setting on uneven ground or slopes, anchor holes or to lay the boom back over the tractor when moving under low clearing overhead obstructions. The boom is equipped with a sheave pulley at top of boom over which a lifting line is operated from a small winch for setting line poles into the holes.

On Type 2 an overhead boom is used for lifting and setting poles, the power being supplied through a small winch connected to the propelling engine.

The augers ordinarily furnished are 12, 16, 20 and 24 inches in diameter and the depth of the hole depends on the length of shaft used. Most diggers are equipped to dig at least 8-foot holes.

The digging speed depends on the type of earth, gravel, etc., where digging is to be done. If in ordinary ground, the devices will easily dig and set from 1 to 1½ miles of line poles per day. Type 3 is especially useful in new construction, but is not economical for spot replacement. The cost of Type 3, the tractor with digging attachment, is approximately \$9,500.

Types 1 and 2 are not as desirable for heavy construction but are useful for spot replacements. The cost of the truck mounted unit is approximately \$4,500. The cost of the small unit is approximately \$2,500.

*Economic Statements**Type 2 post hole digger.*

1. Cost of Equipment:	
(a) Capital Investment.....	\$2,500
(b) Operating Expenses.....	—
(c) Total.....	<u>\$2,500</u>
2. Gross Saving per Annum.....	\$1,800
3. Increased Annual Operating Expenses.....	<u>600</u>
4. Net Reduction in Annual Operating Expenses.....	\$1,200
5. Deduction for Interest Charges @ 4% (of 1-a).....	<u>100</u>
6. Net Saving per Annum.....	<u>\$1,100</u>
7. Annual Return over 4% Interest:	
(a) On Capital Investment ($6 \div 1-a$).....	44%
(b) On Total Cost ($6 \div 1-c$).....	44%

Type 3 post hole digger.

1. Cost of Equipment:	
(a) Capital Investment.....	\$9,500
(b) Operating Expenses.....	—
(c) Total.....	<u>\$9,500</u>
2. Gross Saving per Annum.....	\$8,000
3. Increased Annual Operating Expenses.....	<u>3,300</u>
4. Net Reduction in Annual Operating Expenses.....	\$4,700
5. Deduction for Interest Charges @ 4% (of 1-a).....	<u>380</u>
6. Net Saving per Annum.....	<u>\$4,320</u>
7. Annual Return over 4% Interest:	
(a) On Capital Investment ($6 \div 1-a$).....	45.5%
(b) On Total Cost ($6 \div 1-c$).....	45.5%

Action Recommended

Acceptance as information.

COMMITTEE II—INTERLOCKING

Personnel

H. A. Hudson, Chairman

R. W. Troth, Vice-Chairman

R. B. Amsden

C. F. Brooks

J. J. Clancy

L. Cone

W. A. Ford

D. W. Fuller

C. F. Grundy

E. K. Horns

C. T. Marak

C. B. Mason

H. A. Maynard

H. L. Moseley

K. L. Muse

O. S. Penman

L. E. Scoles

V. P. Shepardson

C. M. Wallace

J. F. Yerger

F. J. Ackerman*

J. P. Hopton*

Signal Section, A.A.R.:

The following outline of work has been assigned:

1. Revision of Manual.
2. Indexing signal literature.
3. Collaborate with A.R.E.A. Committee 5 on switch, frog and crossing layout plans, in order to make layouts as universal as possible for the application of signals and interlocking, including location of insulated rail joints in turn-outs, crossovers and crossings.
4. Requisites for automatic switching in a retarder equipped classification yard.

The Committee submits for consideration, reports on the following subjects**:

1. Revision of Specification 152-50, Manual Part 30.
Revision of Specification 99-46, Manual Part 96.
Revision of Specification 101-50, Manual Part 104.
Revision of Specification 134-43, Manual Part 193.
3. Plans for switches, frogs, crossings, spring and slip switches, collaborating with A.R.E.A. Committee 5—Track.

Information

Specifications, etc., of other organizations referred to in the report of this Committee may be procured from the following:

A.I.S.I.—American Iron & Steel Institute, 350 Fifth Ave., New York 1, N. Y.

A.R.E.A.—American Railway Engineering Association, 59 E. Van Buren St., Chicago 5, Ill.

* Consulting Member.

** Suggestions or criticisms should be submitted in writing to the Chairman of the Committee on or before September 1, 1952.

Disposition of 1951 Letter Ballot Subjects

The following subjects presented by Committee II at the 1951 Annual Meeting were submitted to letter ballot and officially approved:

- Specification 258-51—Interlocking—Now in Manual Part 83.
- Specification for Centralized Traffic Control—Now in Manual Part 97.
- Specification for Electro-Pneumatic Interlocking—Now in Manual Part 79.
- Specification for Electric Interlocking—Now in Manual Part 75.
- Specification for Automatic Interlocking—Now in Manual Part 208.
- Specification for All-Relay Interlocking—Now in Manual Part 209.
- Specification for Electro-Mechanical and Mechanical Interlocking—Now in Manual Part 76.
- Requisites for Movable Bridge Interlocking—Now in Manual Part 64.
- Specification 76-51—Electric Interlocking Machine—Now in Manual Part 85.
- Specification 75-51—Mechanical Interlocking Machine, S. & F. Locking—Now in Manual Part 82.
- Specification 114-46—Mechanical Interlocking Machine, Style "A" Locking—Obsolete—Removed from Manual Part 83.
- Requisites for Mechanically Locking the Levers of Interlocking Machines—Now in Manual Part 99.
- Specification 198-51—Electric Switch Locks—Now in Manual Part 109.
- Specification 150-51—Centralized Traffic Control Machine—Now in Manual Part 98.
- Specification 138-51—Mechanically Operated Circuit Controller for Interlocking Machine Lever—Now in Manual Part 197.

(Revision of A.A.R. Signal Section Specification 152-50)
A.A.R. SIGNAL SECTION SPECIFICATION 152-52.

ELECTRO-PNEUMATIC SWITCH OPERATING MECHANISM

1. *Purpose.*

(a) This specification is for the purpose of providing for an electro-pneumatically operated mechanism with or without dual control for operating and locking switches, derails and other movable apparatus. It sets forth specific detail requirements representing modern signal practice recommended for new installations and for replacement on existing installations when general renewal or replacement becomes desirable.

2. *Requisites, specifications and drawings.*

(a) Requisites, specifications and drawings referred to in the body of this specification form an essential part hereof.

(b) Manufacturer shall furnish with his tender, drawings forming an essential part thereof.

3. *Tender.*

(a) The tender shall be for a product meeting the requirements of this specification in its entirety.

4. *Purchaser's order requirements.*

(a) The following additional requirements will be shown on the Purchaser's order:

1. Details of application.
2. Control circuit characteristics.
3. With or without dual control.
4. Inspection and tests as required.

5. *Material and workmanship.*

(a) Material and workmanship shall be first-class in every respect.

6. *Design and functional requirements.*

(a) Power and hand-throw operation.

1. Mechanism shall operate the switch points to the normal or the reverse position and lock the points in these positions.

2. Mechanism shall perform its operation in the following sequence:

- (a) Unlock switch.
- (b) Operate switch.
- (c) Lock switch.
- (d) Indicate.

6. *Design and functional requirements.*—Continued.

3. Circuit controlling device shall be so designed that its operation will be dependent upon and follow the movement of the mechanism, and that the normally open contacts will remain closed and the normally closed contacts will remain open until the locking dog has entered the locking notch of the lock rod $\frac{1}{2}$ in. or more.

4. Point detector feature shall be dependent upon and follow the movement of the switch point, and shall be so designed that the connection to the switch point can be adjusted so that the circuit controller contacts will not assume the positions corresponding to switch point closure if the switch point is prevented by an obstruction from closing to within $\frac{1}{4}$ in. where latch-out device is not used, and to within $\frac{3}{8}$ in. where latch-out device is used.

5. Mechanism shall be so designed that it can be stopped, reversed, or obstructed at any point of its movement without damage.

(b) Power operation only (mechanisms with or without dual control).

1. Mechanism shall operate under the low requirement shown on Drawing 1457 when supplied with air at 75 lbs. per sq. in. The time of operation at this air pressure and without restricting chokes shall not exceed 2.5 seconds.

2. Mechanism shall be capable of exerting a force of 3,800 lbs. at the end of stroke without damage, when supplied with air at 115 lbs. per sq. in.

3. Mechanism shall be so designed that it will follow the movement of the controller at the point of control.

4. Mechanism shall be so designed that it will hold switch points in locked position in the event of failure of the air supply.

5. Circuit controlling device shall be so designed that the air pressure will be automatically restored to the cylinder in event of the switch becoming partially unlocked.

(c) Hand-throw operation only (dual-control mechanisms).

1. Mechanism shall be so designed that when the hand-throw lever is engaged its position will have a fixed relationship with switch position and will operate the mechanism through the same stroke as when operated by power.

2. To change from hand-throw to power operation, the selector lever shall perform functions in the following sequence:

(a) Check that the hand-throw lever is in one or the other extreme position and lock it in that position.

(b) Disengage the hand-throw lever, close cylinder exhaust ports and open air supply ports.

(c) Close control circuits.

6. *Design and functional requirements.*—Continued.

3. To change from power to hand-throw operation, the selector lever shall perform functions in the following sequence:

(a) Open control circuits.

(b) Close air supply ports and open cylinder exhaust ports; and operate spring clutch so it can engage the hand-throw lever when the lever is aligned with position of the mechanism.

(c) Unlock the hand-throw lever.

(d) Air pressure.

1. Apparatus shall be designed for operation on 60 to 105 lbs. per sq. in.

2. Means shall be provided to either regulate the air supply or restrict the exhaust to control speed of operation.

(e) Mechanism.

1. Mechanism in locked position shall be capable of withstanding stress equivalent to a thrust of 20,000 lbs. either on the switch operating or locking connection.

2. Mechanism and circuit controlling devices shall be enclosed in a substantial metallic weatherproof case designed for mounting on ties. The covers of the case shall be removable and when open shall permit access to all parts. Covers over circuit controlling devices shall be equipped with suitable fastenings for the application of Purchaser's padlock.

3. Mechanism and case shall be so designed that lock rod may be readily removed. Ends of plunger or locking dogs and holes or notches in lock rod shall have square edges. Such holes or notches shall be not more than $\frac{1}{8}$ in. wider than the plunger. Locking dog of switch-and-lock movement shall enter the lock rod $\frac{1}{2}$ in. or more before circuit controller can indicate locked position, and shall have traveled an additional $\frac{1}{2}$ in. or more and extend beyond the lock rod when mechanism has completed its stroke in either normal or reverse position.

4. Mechanism case shall be provided with wire entrance of ample size, conveniently located for access to binding posts.

5. Mechanism and case shall be so designed that they will be applicable for right or left-hand operation and be interchangeable in the field.

6. Mechanism and case shall be so designed that the alignment of the lock and operating connections and the location and kind of fastening to switch ties shall conform to switch layout drawings. Operating rod shall have a maximum stroke of 6 in.

7. Mechanism shall be so designed that all unused openings shall be securely closed, and that the used openings be

6. *Design and functional requirements.*—Continued.

provided with suitable hoods to prevent snow interference.

8. Circuit controlling device and point detector shall be housed in a separate compartment of the mechanism case, which compartment shall, as far as practicable, be non-sweating and dust-proof and have a separate metallic cover.

9. Contact members shall be made of corrosion-resisting metal of sufficient mechanical strength and current-carrying capacity to satisfactorily operate in connection with the circuits used.

10. Movement of the contact members shall be such as will insure a wiping contact.

11. Pipe entrances shall be of ample size and conveniently located for external connections.

(f) *Electro-pneumatic valve.*

1. Electro-pneumatic valve shall be enclosed in a substantial metallic ventilated weatherproof case designed for mounting independent of the switch mechanism, the covering of which case shall be removable and equipped with suitable fastenings for application of Purchaser's padlock, and when open shall permit access to all parts.

2. Case shall be provided with wire entrance of ample size conveniently located for access to binding posts.

3. Circuit controlling device shall be provided to be actuated by and form an integral part of the valve and be so designed that indication circuit carried through it will insure that the valve position corresponds to position of switch and lever before indication is completed.

4. The valve shall be so designed that it will shut off air supply to and will exhaust air from the cylinder through circuit action after switch mechanism has completed its stroke and indication circuit has been completed.

5. Air strainer of sufficient size and so constructed as to insure an adequate supply of air free from foreign substance that may interfere with the operation of the valves or cylinder shall be incorporated in the body of the valve and shall be easily removed for cleaning.

6. Pipe entrance shall be of ample size and conveniently located for external connections.

7. Each valve magnet shall be enclosed in a metallic shell.

8. Magnets shall be designed for operation on d.c. or a.c. as specified by Purchaser, and at voltage as specified by Purchaser.

9. Magnets shall operate satisfactorily when the voltage is reduced 20 per cent below rated voltage.

(g) *Lubrication.*

1. Provision shall be made for convenient lubrication of mechanism.

6. *Design and functional requirements.*—Continued.

2. Exposed oil holes shall be provided with weatherproof oil cups, covers or approved fittings for pressure lubrication. Fittings for pressure lubrication shall be provided where practicable.

7. *Terminal screws and binding posts.*

(a) Terminal screws and washers shall conform to Manufacturer's drawings.

(b) Material for terminal screws and washers shall be in accordance with Specifications for Various Types of Non-Ferrous Metals and Alloys, Manual Part 220.

(c) Threaded receptacles for terminal screws shall be mounted so they cannot be turned in the base or frame to which applied, properly insulated.

(d) Binding posts, nuts and washers shall conform to Drawing 1070, detail 107010.

(e) Binding posts shall be mounted so they cannot be turned in the base or frame to which applied. They shall be properly insulated from each other and other metallic parts.

(f) Binding posts shall be spaced not less than 1 in. centers.

8. *Finish.*

(a) Metal parts, except where parts used are inherently resistant to corrosion, shall be protected against corrosion except where such protection will interfere with the proper functioning of that part. Zinc or cadmium shall not be used on current carrying parts.

(b) Material used for protection against corrosion shall neither soften nor flake under ordinary conditions between temperatures of 40 deg. F. below zero and 185 deg. F. above zero.

9. *Painting.*

(a) Painting shall be in accordance with Specification 120, Manual Part 110.

10. *Coil insulation.*

(a) Coils shall be wound with insulated wire and treated so as not to be injuriously affected by atmospheric conditions or by changes in temperatures between 40 deg. F. below zero and 185 deg. F. above zero.

1. Enameled wire shall be in accordance with Specification 193, Manual Part 183.

2. Cotton-covered wire shall be in accordance with Specification 194, Manual Part 189.

3. Silk-covered wire shall be in accordance with Specification 195, Manual Part 200.

(b) D.C. coils shall be impregnated by vacuum and pressure with insulating compound in accordance with Requisites for Compound for Impregnation of Electrical Windings, Manual Part 171.

10. *Coil insulation.*—Continued.

(c) A.C. coils shall be treated by impregnation or dipping with insulating varnish in accordance with Requisites for Varnish for Treatment of Electrical Windings, Manual Part 174.

(d) When enamel insulation on No. 16 A.W.G. wire or smaller is used on impregnated coils, a cotton thread shall be placed between layers and built up at each end to a minimum wall thickness of $\frac{1}{16}$ in.

(e) Insulating material used for fillers in winding coils shall be chemically neutral.

(f) Coils shall be so insulated that they will withstand the insulation test provided in section 11.

11. *Dielectric requirements.*

(a) Electrical apparatus assembled shall withstand for 1 minute an insulation test, at place of manufacture, of 3,000 volts a.c. between all parts of electric circuits and other metallic parts insulated therefrom.

(b) A surface leakage distance of not less than $\frac{1}{4}$ in. shall be provided between any exposed metallic part of the apparatus carrying current and any other metallic part thereof.

(c) Separate windings, which are insulated from each other, shall withstand for 1 minute an insulation test of 3,000 volts a.c. between their terminals.

(d) A potential of twice the normal operating requirements at a suitable frequency shall be impressed across the windings of alternating current coils without any excessive flow of current indicating a short circuit.

12. *Identification.*

(a) Mechanism shall be plainly marked with Manufacturer's references.

(b) Magnet coils and resistors shall be plainly marked with Manufacturer's references.

13. *Inspection.*

(a) Purchaser may inspect the material or product at all stages of manufacture.

(b) Purchaser may inspect the completed product to determine that the requirements of this specification have been met.

(c) If product has not been accepted at point of production and if, upon arrival at destination, it does not meet the requirements of this specification, it may be rejected, and the Manufacturer, upon request, shall advise the Purchaser what disposition is to be made of the rejected product. Manufacturer shall pay all freight charges.

(d) If Purchaser is to make inspection at point of production it shall be so stated on Purchaser's order.

14. *Tests.*

(a) Tests may be made at point of production, or on samples submitted, and may also be made at destination.

(b) Manufacturer shall give the Purchaser sufficient notice of time when the material or product will be ready for testing.

(c) Manufacturer shall provide, at point of production, apparatus and labor for making required tests under supervision of the Purchaser.

(d) If tests are to be made at point of production, it shall be so stated on Purchaser's order. The Purchaser shall indicate which of the tests herein specified are to be made and what portion of the material or product shall be tested.

15. *Packing.*

(a) Product shall be so assembled or packed as to permit convenient handling and to protect against loss or damage during shipment.

16. *Marking.*

(a) Purchaser's order, requisition and package number, name of Consignor, and name and address of Consignee, shall be plainly marked on outside of packages and on tags attached to loose pieces.

(b) Detail list of loose pieces, packages and their contents shall be furnished for each shipment. Where carload shipments are made, routing and car identification shall be shown.

17. *Warranty.*

(a) Manufacturer shall warrant the product covered by this specification to be free from defects in material and workmanship under ordinary use and service, his obligation under this warranty being limited to manufacturing, at point of production, any part or parts to replace those which shall be found defective within 1 year after shipment to the Purchaser. This warranty shall not apply to any product which shall have been repaired or altered in any way by anyone other than the Manufacturer thereof, so as to affect, in the Manufacturer's judgment, its proper functioning or reliability, or which has been subjected to misuse, negligence or accident.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Specification 152-50—Electro-Pneumatic Switch
Operating Mechanism, Manual Part 30.

(Revision of A.A.R. Signal Section Specification 99-46)
A.A.R. SIGNAL SECTION SPECIFICATION 99-52.

ELECTRIC LOCKS FOR INTERLOCKING MACHINES

1. *Purpose.*

(a) This specification is for the purpose of providing for electric locks for first and second voltage ranges for application to interlocking machines. It sets forth specific detail requirements representing modern signal practice recommended for new installations and for replacement on existing installations when general renewal or replacement becomes desirable.

2. *Requisites, specifications and drawings.*

(a) Requisites, specifications and drawings referred to in the body of this specification form an essential part hereof.

(b) Manufacturer shall furnish with his tender, drawings forming an essential part thereof.

3. *Tender.*

(a) The tender shall be for a product meeting the requirements of this specification in its entirety.

4. *Purchaser's order requirements.*

(a) The following additional requirements will be shown on the Purchaser's order:

1. Details of application.
2. Circuit characteristics for operation of lock, including voltage, amperes and frequency requirements.
3. Designation of special contact openings.
4. Designation of contact circuit load.
5. Designation of contact arrangement for opening and closing.
6. Special features.
7. Inspection and tests as required.
8. Alternate requisites as required.

5. *Alternates.*

(a) The provisions contained in the alternate requisites section of this specification form a part hereof only when substituted by Purchaser's order for the provisions contained in this specification.

6. *Material and workmanship.*

(a) Material and workmanship shall be first-class in every respect.

7. *Design.*

(a) Lock shall be designed to prevent improper operation due to vibration or external force applied to the connections or case.

(b) Locks shall be of the forced-drop type in which the locking member is mechanically actuated to the locked position by the manipulation of the lever or latch handle.

(c) Notches in the quadrant, slide bar, or lever of normal and reverse locks shall be of such length that the locking dog or plunger can drop freely when lever or latch is moved away from the normal or reverse position as far as is permitted by worn mechanical locking on the particular type of machine to which the lock is applied.

(d) Locks applied to mechanical machines.

1. The notch in the quadrant or slide bar shall be so cut that the locking face will meet squarely against the locking dog. Notch shall be at least $\frac{7}{32}$ in. deep and of length to provide at least $\frac{1}{4}$ in. back clearance. With lock de-energized, the locking dog or plunger shall engage quadrant or slide bar at least $\frac{3}{16}$ in. and shall clear bottom of notch in quadrant or slide bar. When lock is energized the locking dog or plunger shall clear top of slide bar or quadrant at least $\frac{1}{32}$ in.

2. Each lock shall be enclosed in a separate substantial metallic case, the door or covering of which shall be equipped with suitable fastening for application of Purchaser's padlock and when open shall permit access to all parts.

*R-7-d-2.

3. Operating connection between interlocking machine lever and lock shall be so designed that it cannot be disconnected without removing the seal. *R-7-d-3.

(e) Locks shall have sufficient clearance between fixed and movable parts to provide free movement.

(f) Armature endplay shall be not less than 0.010 nor more than 0.020 inch in d.c. lock, and not less than 0.030 nor more than 0.035 inch in a.c. lock.

(g) Lock shall operate satisfactorily when the voltage is reduced to 80 per cent of rated voltage.

(h) Binding posts shall be spaced not less than 1 in. centers.

(i) Minimum clearance of $\frac{1}{8}$ in. shall be provided between non-insulated current-carrying parts and other metallic parts.

(j) Mechanism shall be so constructed that any part may be readily removed.

(k) Bolts, nuts and threads shall be in accordance with Specifications for Bolts, Nuts and Threads, Manual Part 17.

(l) Bolts and screws shall be provided with lock washers where practicable.

(m) Provision shall be made for proper and convenient lubrication of mechanism.

* Alternate requisites section.

7. *Design.*—Continued.

(n) Wire entrance shall be of ample size, conveniently located for access to binding posts, and arranged to protect wires from mechanical injury.

(o) Like parts of same Manufacturer's apparatus shall be interchangeable.

8. *Coils.*

(a) Coils shall be so made that they may be replaced without changing the magnetic and mechanical adjustment. When in place the coils shall be secured to prevent their movement by vibration.

(b) Connecting terminals of coils shall be joined either by a 14-24 or 10-32 binding post. Terminal leads of coils shall be of strands of tinned copper not larger than No. 28 A.W.G. wire. The aggregate cross-section of the strands shall at least equal that of a No. 18 A.W.G. wire. Leads shall be soldered to coil terminal wires using corrosion-resisting flux and shall be so insulated that they will withstand the insulation test provided in section 14.

(c) Coils shall be protected in a suitable manner from mechanical injury.

(d) At 68 deg. F., the percentage of variation in the resistance of individual coils shall not exceed:

1. For 5 ohms or less, plus or minus 5 per cent.
2. Above 5 ohms, plus or minus 10 per cent.

(e) Each coil shall be plainly and permanently marked, showing the Manufacturer's reference, nominal resistance, number of turns, size of wire and kind of wire insulation on a tag of non-conductive material adjacent to the outside lead.

(f) All coils shall be full wound and the number of turns shall not be permitted to vary more than 5 per cent, plus or minus, for any given coil. If a resistance above 5 ohms is specified, which cannot be obtained with standard A.W.G. wire, using full-wound coils, the Manufacturer may furnish the nearest resistance to this value, using full-wound coils with standard A.W.G. wire.

9. *Contacts.*

(a) Contacts shall be made of suitable metal of sufficient mechanical strength.

(b) Material used in affixing contact elements shall not cause corrosion.

(c) Finger contacts shall meet contact surfaces squarely and simultaneously.

(d) Fingers shall have a slide movement of not less than 0.010 in. against contact surface.

(e) Contact opening shall be not less than 0.050 in.

10. *Finish.*

(a) Metal parts shall be protected against corrosion except where such protection will interfere with the proper functioning of that part.

(b) Material used for protection against corrosion shall neither melt nor flake under atmospheric conditions between temperatures of 40 deg. F. below zero and 185 deg. F. above zero.

11. *Painting.*

(a) Painting shall be in accordance with Specification 120, Manual Part 110.

12. *Binding posts.*

(a) Binding posts, nuts and washers shall conform to Drawing 1070.

(b) Binding posts shall be mounted so they cannot be turned in the base or frame to which applied. They shall be properly insulated from each other and other metallic parts.

13. *Coil insulation.*

(a) Coils shall be wound with insulated wire and treated so as not to be injuriously affected by atmospheric conditions or by changes in temperatures between 40 deg. F. below zero and 185 deg. F. above zero.

1. Enameled wire shall be in accordance with Specification 193, Manual Part 183.

2. Cotton-covered wire shall be in accordance with Specification 194, Manual Part 189.

3. Silk-covered wire shall be in accordance with Specification 195, Manual Part 200.

(b) Coils external to the housing of moving parts shall be impregnated by vacuum and pressure with insulating compound in accordance with Requisites for Compound for Impregnation of Electrical Windings, Manual Part 171.

(c) Coils adjacent to moving parts, armature air gaps or contacts shall be treated by impregnation or dipping with insulating varnish in accordance with Requisites for Varnish for Treatment of Electrical Windings, Manual Part 174.

(d) When enamel insulation on No. 16 A.W.G. wire or smaller is used on impregnated coils, a cotton thread shall be placed between layers and built up at each end to a minimum wall thickness of $\frac{1}{16}$ in.

(e) Insulating material used for fillers in winding coils shall be chemically neutral.

(f) Coils shall be so insulated that they will withstand the insulation test provided in section 14. This test shall be made by mounting coil on a snugly fit metal mandrel and making breakdown tests between mandrel and winding; also by standing coil on each end in turn on a metal plate and testing between plate and winding.

14. *Dielectric requirements.*

(a) Electrical apparatus assembled shall withstand for 1 minute an insulation test, at place of manufacture, of 3,000 volts a.c. between all parts of electric circuits and other metallic parts insulated therefrom.

(b) A surface leakage distance of not less than $\frac{1}{4}$ in. shall be provided between any exposed metallic part of the apparatus carrying current and any other metallic part thereof.

(c) Separate windings, which are insulated from each other, shall withstand for 1 minute an insulation test of 3,000 volts a.c. between their terminals.

(d) A potential of twice the normal operating requirements at a suitable frequency shall be impressed across the windings without any excessive flow of current indicating a short circuit.

15. *Identification.*

(a) Locks shall be plainly marked with Manufacturer's references.

16. *Inspection.*

(a) The product furnished under this specification may be accepted upon Manufacturer's certificates of guarantee insuring that it is in accordance with the specification. If on arrival at destination the product is found not to meet the requirements of the specification it may be rejected and the Manufacturer, upon request, shall advise the Purchaser what disposition is to be made of the rejected product. Manufacturer shall pay all freight charges.

17. *Tests.*

(a) Tests may be made at point of production, or on samples submitted, and may also be made at destination.

(b) Manufacturer shall give the Purchaser sufficient notice of time when the material or product will be ready for testing.

(c) Manufacturer shall provide, at point of production, apparatus and labor for making required tests under supervision of the Purchaser.

(d) If tests are to be made at point of production, it shall be so stated on Purchaser's order. The Purchaser shall indicate which of the tests herein specified are to be made and what portion of the material or product shall be tested.

18. *Packing.*

(a) Product shall be so assembled or packed as to permit convenient handling and to protect against loss or damage during shipment.

19. *Marking.*

(a) Purchaser's order, requisition and package number, name of Consignor, and name and address of Consignee, shall be plain-

19. *Marking.*—Continued.

ly marked on outside of packages and on tags attached to loose pieces.

(b) Detail list of loose pieces, packages and their contents shall be furnished for each shipment. Where carload shipments are made, routing and car identification shall be shown.

20. *Warranty.*

(a) Manufacturer shall warrant the product covered by this specification to be free from defects in material and workmanship under ordinary use and service, his obligation under this warranty being limited to manufacturing, at point of production, any part or parts to replace those which shall be found defective within 1 year after shipment to the Purchaser. This warranty shall not apply to any product which shall have been repaired or altered in any way by anyone other than the Manufacturer thereof, so as to affect, in the Manufacturer's judgment, its proper functioning or reliability, or which has been subjected to misuse, negligence or accident.

Alternate requisites.

R-7-d-2.

Each lock shall be enclosed in a separate substantial metallic case, the door or covering of which shall be equipped with suitable fastening for application of { seal } and when open shall permit access to all parts.

R-7-d-3.

Operating connections between interlocking machine lever and lock shall be so designed that it cannot be disconnected without removing.....

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Specification 99-46—Electric Locks for Interlocking Machines,
Manual Part 96.

(Revision of A.A.R. Signal Section Specification 101-50)
A.A.R. SIGNAL SECTION SPECIFICATION 101-52.

ELECTRIC MOTOR SWITCH OPERATING MECHANISM

Proposed Revision

6. *Design and functional requirements.*

(d) Mechanism.

2. Mechanism and case shall be so designed that lock rod may be readily removed. Ends of plunger or locking dogs and holes or notches in lock rod shall have square edges. Such holes or notches shall be not more than $\frac{1}{8}$ in. wider than the plunger. Locking dog of switch-and-lock movement shall enter lock rod $\frac{1}{2}$ in. or more before circuit controller can indicate locked position and shall have traveled an additional $\frac{1}{2}$ in. or more and extended beyond the lock rod when mechanism has completed its stroke in either normal or reverse position.

8. Point detector feature shall be dependent upon and follow the movement of the switch point, and shall be so designed that the connection to the switch point can be adjusted so that the circuit controller contacts will not assume the position corresponding to switch point closure if the switch point is prevented by an obstruction from closing to within $\frac{1}{4}$ in. where latch-out device is not used, and to within $\frac{3}{8}$ in. where latch-out device is used.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Sections 6-d-2 and 6-d-8 of Specification 101-50—Electric Motor Switch Operating Mechanism, Manual Part 104.

(Revision of A.A.R. Signal Section Specification 134-43)
A.A.R. SIGNAL SECTION SPECIFICATION 134-52.

ELECTRO-MECHANICAL INTERLOCKING MACHINE

1. *Purpose.*

(a) This specification is for the purpose of providing for an electro-mechanical interlocking machine for the control of signals, switches and other interlocking units. It sets forth specific detail requirements representing modern signal practice recommended for new installations and for replacement on existing installations when general renewal or replacement becomes desirable.

2. *Requisites, specifications, drawings and instructions.*

(a) Requisites, specifications, drawings and instructions referred to in the body of this specification form an essential part hereof.

(b) Manufacturer shall furnish with his tender, drawings forming an essential part thereof.

3. *Tender.*

(a) The tender shall be for a product meeting the requirements of this specification in its entirety.

4. *Purchaser's order requirements.*

(a) The following additional requirements will be shown on the Purchaser's order:

1. Track and signal plan drawn to scale.
2. Designation of levers, working and spare, and spare lever spaces.
3. Sequence for numbering of levers.
4. Control circuit characteristics including voltage, amperes and frequency requirements.
5. Electric lever locks and time releases.
6. Lever lights.
7. Color for enamel finish.
8. Designation of lead-out, vertical or horizontal.
9. Designation of lever counterweights, if required.
10. Special features.
11. Inspection and tests as required.
12. Alternate requisites as required.

5. *Alternates.*

(a) The provisions contained in the alternate requisites section of this specification form a part hereof only when substituted by Purchaser's order for the provisions contained in this specification.

6. *Material and workmanship.*

- (a) Material and workmanship shall be first-class in every respect.

7. *Design.*

(a) Mechanical section.

- 1. Mechanical section shall be in accordance with Specification 75, Manual Part 82, except to omit locking and locking bed when mechanical locking is provided in the electric section.

(b) Electric section.

- 1. Electric section shall be assembled in a supporting structure securely fastened to the mechanical section, and:

- (a) When designed for operation of mechanical locking in the mechanical section:

- 1. The supporting structure shall be provided with $3\frac{1}{8}$ in. minimum clearance above the locking bed in the mechanical section.

- 2. The electric levers shall be individual units, each complete with its own housing, and shall be in accordance with Specification 76, Manual Part 85, except for mechanical locking.

- (b) When designed to include mechanical locking in the electric section, the electric levers and mechanical locking shall be assembled in a common housing and shall be in accordance with Specification 76, Manual Part 85.

- 2. Operating rods between electric levers and locking drivers, or bolt locks, and angle supports for electric section legs shall be made of steel, AISI-C1020.

- 3. Electric levers shall be spaced:

- (a) 5 in., center to center, on unit lever type sections.
 - (b) $2\frac{1}{2}$ in., center to center, on miniature mechanical locking type sections, with alternate levers suitable for locking the levers in the mechanical section.

8. *Levers.*

- (a) Levers shall have equal and uniform throw and shall be true in alignment.

- (b) Levers shall be so arranged that they can be removed without interfering with the operation of other levers.

- (c) Levers shall be designed to latch in each operating position.

- (d) Levers shall be designed to permit the application of electric locks and mechanical time releases independently of indication locks.

9. *Mechanical locking.*

(a) Mechanical locking shall be in accordance with Requisites for Mechanically Locking the Levers of Interlocking Machines, Manual Part 99.

(b) Locking bed shall be of ample size to accommodate future locking for spare levers and spaces.

(c) Locking shall be distributed as uniformly as possible without crowding and so arranged as to be accessible.

(d) Each lever space shall be fully equipped with locking brackets, or plates, cross-locking and locking bars.

(e) Direct locking shall be used wherever possible.

(f) Dogs for three-position levers shall have nose extended, where required, to prevent cross-locking from being displaced.

(g) Locking dogs, trunnions and stops shall be riveted to bars.

(h) Locking faces shall fit squarely against each other with a minimum engagement, when locked, of at least three-fourths the designed locking face.

(i) Locking and connections must be so designed that when a lever or latch is mechanically locked, the following will be prevented:

1. Latch operated locking. Raising lever latch block so that bottom thereof is within $\frac{1}{4}$ in. of top of quadrant.

2. Lever moving in horizontal plane. Moving lever more than $\frac{1}{4}$ in. when in normal position or more than $\frac{1}{2}$ in. when in reverse position.

3. Lever moving in an arc. Moving lever more than 3 deg.

10. *Electric lever locks.*

(a) Locks shall be in accordance with Specification 99, Manual Part 96.

(b) Locks shall be provided on levers specified by the Purchaser.

(c) Circuit characteristics for operation of lock shall be as specified by the Purchaser.

11. *Electric lever locking.*

(a) Levers used for the control of switches, derails, movable point frogs or apparatus that requires equivalent protective circuits shall be provided with:

1. A device to insure the locking of the units in a position corresponding to the position of the lever before the mechanical locking is released.

2. A device to prevent the movement of the lever from the normal or reverse position when the protecting track circuit is occupied.

11. *Electric lever locking.*—Continued.

3. A normally open latch circuit controller for electric locking circuits.

(b) Levers used for controlling signals shall be equipped with devices to prevent the release of the mechanical locking until the signals directly controlled are in normal position.

(c) Indication locks shall be arranged to check the movement of levers at the indicating points; lock plunger or latch shall be forced to locked position mechanically.

(d) Switch lever locks shall be arranged to lock the levers in the normal and reverse positions. Lock plungers shall be forced to the locked position mechanically for the normal and reverse positions.

12. *Locking between mechanical and electric sections.*

(a) Mechanical locking shall be provided between mechanical and electric levers.

(b) Mechanical locking, when provided in the electric section, shall be of the miniature type and shall be operated by either the electric or mechanical levers.

(c) When mechanical locking is provided in the electric section, a bolt lock shall be provided, between mechanical lever and its indicating electric lever, to so operate that the latch of the mechanical lever cannot be manipulated until the electric lever is moved to midstroke, and shall hold electric lever at midstroke until mechanical lever is latched in its normal or reverse position.

(d) Adjusting screws and lock nuts shall be provided:

1. On machines having locking in the mechanical section, on operating rod between electric lever and locking driver.

2. On machines having locking in the electric section, on bolt lock connecting rod between electric and mechanical levers.

13. *Time releases.*

(a) Time releases shall be installed as required by the Purchaser and shall be in accordance with Specification 128, Manual Part 129, where applicable.

(b) Setting of time releases shall be in accordance with Instructions for Time Releases Applied to Signal Apparatus, Manual Part 128. *R-13-b.

14. *Circuit controllers.*

(a) Circuit controllers shall be in accordance with Specification 138, Manual Part 197.

* Alternate requisites section.

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15. *Lever lights.*

(a) Lever lights shall be provided in the front of the machine immediately above or below the levers, for levers as specified by the Purchaser.

16. *Electric lamps.*

(a) Incandescent electric lamps shall be in accordance with Specification 51, Manual Part 91, and conform to Drawings 1541, 1542 and 1543.

17. *Binding posts.*

(a) Binding posts, nuts and washers for making connection leading from the machine to other signal equipment shall be provided and shall conform to Drawing 1070, assembly 107010.

(b) Binding posts shall be mounted so they cannot be turned in the base or frame to which applied. They shall be properly insulated from each other and other metallic parts.

(c) Supports for binding posts shall be of such material that wire connections will not loosen due to shrinkage.

(d) Binding posts for external wires shall, as far as practicable, be located adjacent to wire inlet, and duct spaces provided.

18. *Cases.*

(a) Electric section, having mechanical locking, shall be enclosed in a metal case having removable covers and panels of convenient size to permit full access to all parts.

(b) Electric section, having individual electric lever units shall have each unit enclosed in a metal case having removable covers to permit full access to all parts.

(c) Cases shall be equipped for Purchaser's padlock. *R-18-c.

19. *Finish.*

(a) Metal parts shall be protected against corrosion except where such protection will interfere with the proper functioning of that part.

(b) Material used for protection against corrosion shall neither melt nor flake under atmospheric conditions between temperatures of 40 deg. F. below zero and 185 deg. F. above zero.

20. *Painting.*

(a) Painting shall be in accordance with Specification 120, Manual Part 110.

21. *Coil insulation.*

(a) Coils shall be wound with insulated wire and treated so as not to be injuriously affected by atmospheric conditions or by changes in temperatures between 40 deg. F. below zero and 185 deg. F. above zero.

* Alternate requisites section.

21. Coil insulation.—Continued.

1. Enameled wire shall be in accordance with Specification 193, Manual Part 183.

2. Cotton-covered wire shall be in accordance with Specification 194, Manual Part 189.

3. Silk-covered wire shall be in accordance with Specification 195, Manual Part 200.

(b) Coils external to the housing of moving parts shall be impregnated by vacuum and pressure with insulating compound in accordance with Requisites for Compound for Impregnation of Electrical Windings, Manual Part 171.

(c) Coils adjacent to moving parts, armature air gaps or contacts shall be treated by impregnation or dipping with insulating varnish in accordance with Requisites for Varnish for Treatment of Electrical Windings, Manual Part 174.

(d) When enamel insulation on No. 16 A.W.G. wire or smaller is used on impregnated coils, a cotton thread shall be placed between layers and built up at each end to a minimum wall thickness of $\frac{1}{16}$ in.

(e) Insulating material used for fillers in winding coils shall be chemically neutral.

(f) Coils shall be so insulated that they will withstand the insulation test provided in section 22. This test shall be made by mounting coil on a snugly fit metal mandrel and making breakdown tests between mandrel and winding; also by standing coil on each end in turn on a metal plate and testing between plate and winding.

22. Dielectric requirements.

(a) Electrical apparatus assembled shall withstand for 1 minute an insulation test, at place of manufacture, of 3,000 volts a.c. between all parts of electric circuits and other metallic parts insulated therefrom, except the lamp receptacle which shall withstand for 1 minute an insulation test of 800 volts a.c.

(b) A surface leakage distance of not less than $\frac{1}{4}$ in. shall be provided between any exposed metallic part of the apparatus carrying current and any other metallic part thereof.

(c) Separate windings, which are insulated from each other, shall withstand for 1 minute an insulation test of 3,000 volts a.c. between their terminals.

(d) A potential of twice the normal operating requirements at a suitable frequency shall be impressed across the windings without any excessive flow of current indicating a short circuit.

23. Identification.

(a) Magnet coils and resistors shall be plainly marked with Manufacturer's references.

24. *Inspection.*

(a) Purchaser may inspect the material or product at all stages of manufacture.

(b) Purchaser may inspect the completed product to determine that the requirements of this specification have been met.

(c) If product has not been accepted at point of production and if, upon arrival at destination, it does not meet the requirements of this specification, it may be rejected, and the Manufacturer, upon request, shall advise the Purchaser what disposition is to be made of the rejected product. Manufacturer shall pay all freight charges.

(d) If Purchaser is to make inspection at point of production it shall be so stated on Purchaser's order.

25. *Tests.*

(a) Tests may be made at point of production, or on samples submitted, and may also be made at destination.

(b) Manufacturer shall give the Purchaser sufficient notice of time when the material or product will be ready for testing.

(c) Manufacturer shall provide, at point of production, apparatus and labor for making required tests under supervision of the Purchaser.

(d) If tests are to be made at point of production, it shall be so stated on Purchaser's order. The Purchaser shall indicate which of the tests herein specified are to be made and what portion of the material or product shall be tested.

26. *Packing.*

(a) Product shall be so assembled or packed as to permit convenient handling and to protect against loss or damage during shipment.

27. *Marking.*

(a) Purchaser's order, requisition and package number, name of Consignor, and name and address of Consignee, shall be plainly marked on outside of packages and on tags attached to loose pieces.

(b) Detail list of loose pieces, packages and their contents shall be furnished for each shipment. Where carload shipments are made, routing and car identification shall be shown.

28. *Warranty.*

(a) Manufacturer shall warrant the product covered by this specification to be free from defects in material and workmanship under ordinary use and service, his obligation under this warranty being limited to manufacturing, at point of production, any part or parts to replace those which shall be found defective

28 *Warranty.*—Continued.

within one year after shipment to the Purchaser. This warranty shall not apply to any product which shall have been repaired or altered in any way by anyone other than the Manufacturer thereof, so as to affect, in the Manufacturer's judgment, its proper functioning or reliability, or which has been subjected to misuse, negligence or accident.

Alternate requisites.

R-13-b.

Setting of time releases shall be.....

R-18-c.

Cases shall be equipped for:

1.padlocks.
2.cabinet locks.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter
in the Manual.

Subject-matter to be Superseded

Specification 134-43—Electro-Mechanical Interlocking Machine;
Manual Part 193.

PLANS FOR SWITCHES, FROGS, CROSSINGS, SPRING AND
SLIP SWITCHES, COLLABORATING WITH A.R.E.A.
COMMITTEE 5—TRACK

At the 1950 Annual Meeting* Committee II presented a report which included a list of revised A.R.E.A. track work plans which were adopted as recommended practice at the A.R.E.A. Annual Meeting in Chicago, Ill., on March 14, 1951, for publication in the Portfolio of Track Work Plans.

Two additional A.R.E.A. track work plans required correction to agree with the revised lengths of curved split switches adopted in 1951. Accordingly the following revised plans were presented and adopted as recommended practice at the A.R.E.A. Annual Meeting in Chicago, Ill., on March 13, 1952, for publication in the Portfolio of Track Work Plans:

Plan 912-52—Bills of Switch Ties for Turnouts and Crossovers

Plan 921-52—Location of Joints for Turnouts with Curved Split Switches

The data shown on Plan 912-52 is based on switch ties 7 by 9 inches with tie spacing approximately 20 inches center to center.

The insulated joints shown on Plan 921-52 are located to conform to A.A.R. Signal Section current Drawings 1634, 1635 and 1637 and if other rail lengths are used, the stagger of the joints must not exceed 4 feet 6 inches. Rail lengths provide for $\frac{3}{8}$ inch end posts at insulated joints.

Action Recommended

Acceptance as information.

* A.A.R. Signal Section 1950 Proceedings, Vol. XLVIII, pp. 139 and 380.

COMMITTEE III—SIGNAL SHOP PRACTICE

Personnel

P. P. Ash, Chairman

R. E. Testerman, Vice-Chairman

D. C. Bettison

H. V. Stone

E. R. Frachiseur

E. S. Taylor

J. E. Hillig

W. M. Vogts

J. G. Karlet

A. M. Weeks

W. Poole

J. F. Yerger

J. P. Stevely

E. H. Branson*

A. W. Fisher*

Signal Section A.A.R.:

The following outline of work has been assigned:

1. Revision of Manual.
2. Indexing signal literature.
3. Investigate and report on the factors involved in the establishment of repair facilities.
4. Shop practices and facilities used in testing and repairing spring switch buffers.

The Committee submits for consideration, reports on the following subjects**:

3. Establishment of repair facilities.

Cooperative report. Purchases and Stores Division, A.A.R.—General Reclamation Committee.

ESTABLISHMENT OF REPAIR FACILITIES

An effort is being made to inspect typical established shop facilities on various railroads so that some helpful information can be made available relative to the factors involved and the degree of their conformance with a typical shop layout previously submitted by Committee III*.

Two such inspections were made by the Committee during the past year, the Erie R. R. shop at Meadville, Pa. on June 6, 1951 and the Norfolk & Western Ry. shop at Roanoke, Va. on November 14, 1951.

Erie R.R. Signal Shop.

The shop building is located approximately in the center of the Erie System and has brick walls, cement floor and frame roof. The shop is contained in a part of the Stores Department building and includes an area of 54 by 142 feet, all on the ground floor level. It is well arranged and lighted, both naturally and artificially, and is a very practical example of a signal shop layout previously outlined by Committee III.

* Consulting Member.

** Suggestions or criticisms should be submitted in writing to the Chairman of the Committee on or before September 1, 1952.

The shop is located adjacent to the storeroom and the Stores Department handles all the incoming and outgoing material. All work performed in the shop is done under shop orders issued by the Storekeeper.

At the time of the inspection the shop forces consisted of 16 employees, as follows:

- 1 Foreman
- 2 Leading Signal Mechanics
- 9 Signalmen
- 2 Assistant Signalmen
- 2 Signal Helpers

This force reports directly to the Signal Engineer's office.

The nature of the equipment, as well as its arrangement, is indicated on shop layout plan, Fig. 1. It will be noted that the general repairs are made in the main shop, while relays, C.T.C. apparatus and like equipment are handled in the enclosed area shown on Fig. 1 as "Relay & C.T.C. Repair Room."

The general repairs consist principally of all the items used by the Signal Department of the Erie R. R., including signal mechanisms, switch machines, both electric and pneumatic, signal masts, etc., and a space is provided for the regrounding of track bond drills.

From the records on direct current relays repaired in this shop, it was disclosed that the average monthly production was 110 relays, which utilized 468 man hours, giving an average of 4.25 man hours per relay.

All facilities in the shop are used for signal repairs, there being no attempt to manufacture any signal apparatus.

Photographs of the interior of the shop are shown in Figs. 2, 3, 4 and 5.

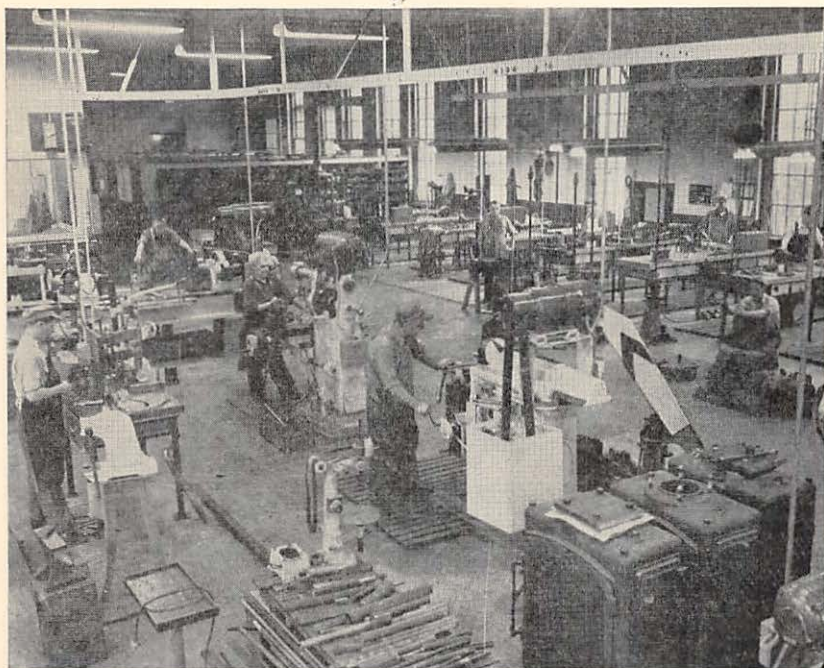


Fig. 2.

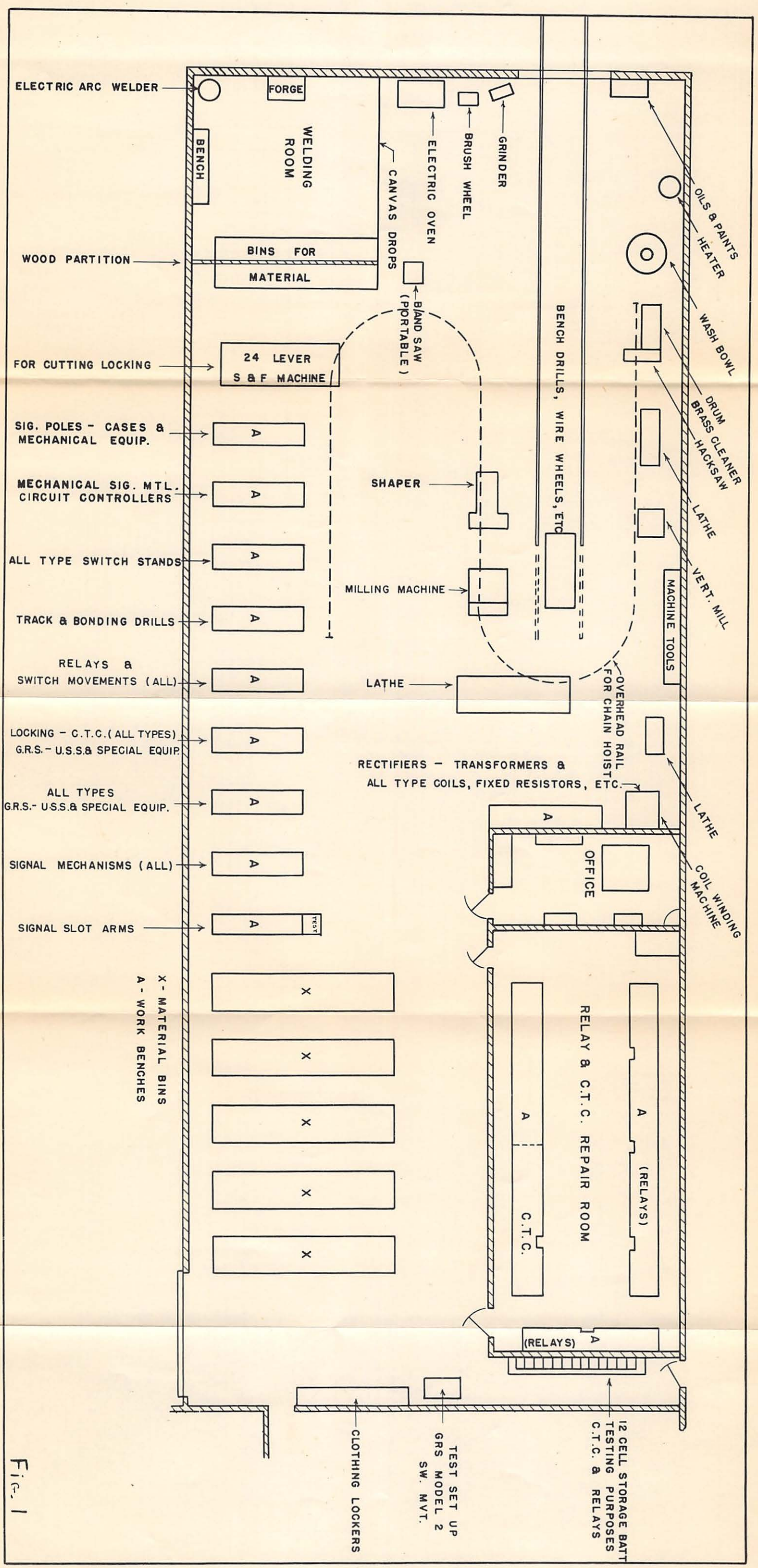


Fig. 1



Fig. 3.

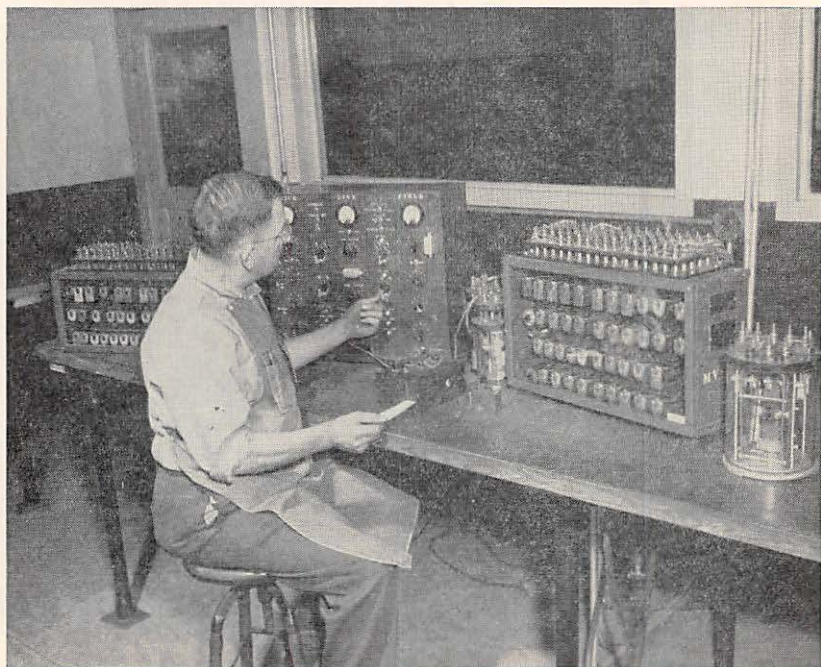


Fig. 4.

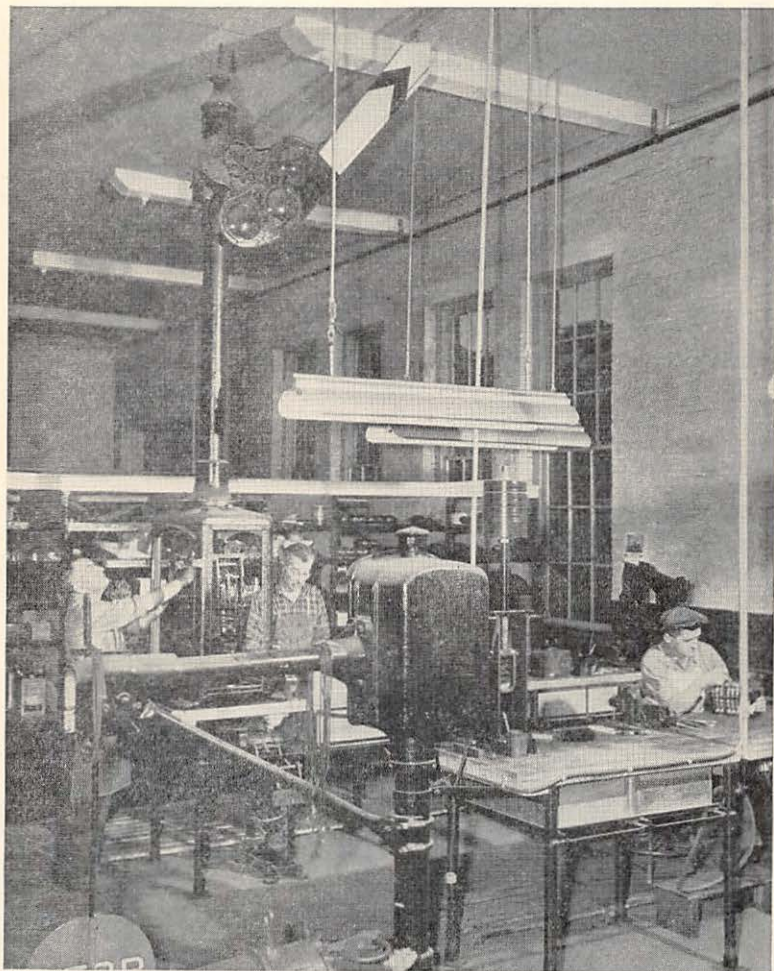


Fig. 5.

Norfolk & Western Ry. Reclamation Shop.

This layout centers around a three-story building which has approximately 14,000 square feet of floor space. There is a considerable area around this building, which is used for the storage of material to be repaired or reclaimed, and the area is also used to wire large cases and other instrument housings. The force consisted of 38 employees.

The operation of this shop is a definite departure from the usual type of shop handling signal repairs, in that they repair, reclaim and fabricate many items in addition to signal apparatus. It was noted that part of the track motor car repairs for the system as well as the repair of gasoline-driven Maintenance-of-Way Department tools were included.

The original shop was set up in 1920, with one man and one bench. Since that time it has expanded to its present size, utilizing space when and as available. The present shop operation is now carried on with each type of repair confined to a room or space allotted to the various operations. Table I lists repair facilities and equipment.

The Signal Storekeeper is located in the shop building and although he reports to the General Storekeeper, his instructions and guidance as to stock requirements are issued by the Superintendent of Telegraph and Signals.

The Storekeeper stores the new material as received and also handles material returned by the field forces to be repaired. When material is returned by field forces, it is screened by a supervisor who considers the possible future use of the various items. If the item is suitable for repair and the estimated

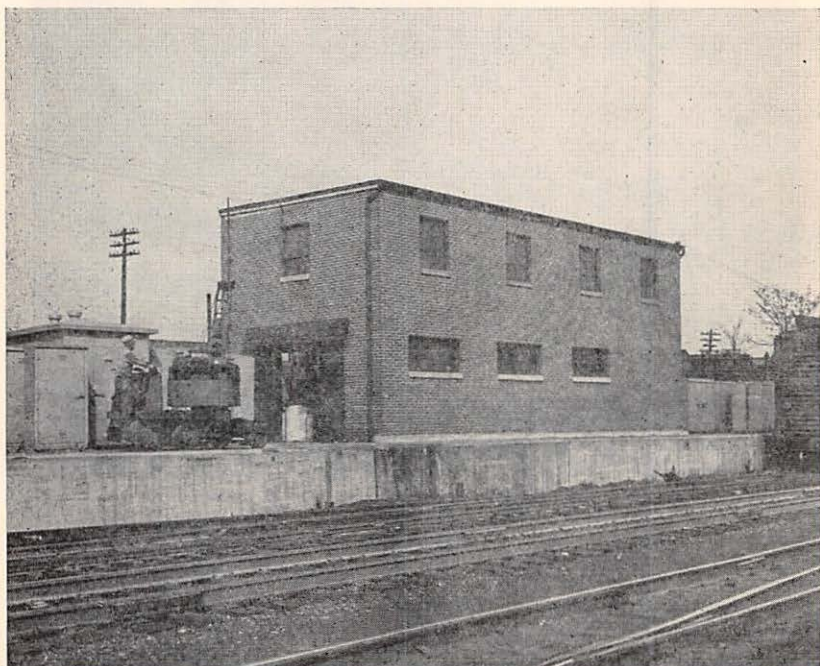


Fig. 6.



Fig. 7.



Fig. 8.

cost is not excessive, it is scheduled for repairs by the Shop Foreman. The item is then covered by a shop order, is processed through the various stages, and when repairs have been completed is returned to be carried in stock.

A separate two-story fireproof building is located within the shop area, in which all case and instrument house wiring is handled for construction work on the entire system. A signal construction force consisting of a Foreman and from six to ten men of the various signal construction force classifications, depending on the current authorities, handles this phase of the work. In order to familiarize all Construction Department employees with case wiring, construction forces are rotated periodically. Figs. 6, 7 and 8 show the case wiring department.

In general, the Norfolk & Western operation is noteworthy as they, in spite of the complications imposed by the widely diversified activities, adhere to the principles previously set forth by Committee III in connection with costs, arrangement and procedure*.

TABLE I

Repair Facilities and Equipment

Machine Shop.

- 1—24" x 7' lathe
- 1—12" x 54" lathe
- 1—12" x 30" lathe
- 1—Sellers bonding drill grinder
- 1—Do-All Metal Master 16" capacity saw and filing machine
- 1— $\frac{1}{2}$ " floor model drill press
- 1—Pipe threading machine
- 1—7" bench grinder
- 1—20" drill press
- 1—Hydraulic press 50-ton

Carpenter Shop.

- 1—24" band saw
- 1—10" combination rip and cut-off saw and 6" jointer
- 1—8" jointer
- 1— $\frac{1}{2}$ " floor model drill press
- 1—Portable belt sander
- 1— $\frac{1}{4}$ " portable electric drill
- 1— $\frac{1}{2}$ " portable electric drill
- 1—Portable electric screwdriver
- 1—Skilsaw

* A.A.R. Signal Section 1950 Proceedings, Vol. XLVIII, p. 155, and A.A.R. Signal Section 1949 Proceedings, Vol. XLVII, pp. 93-96, inclusive.

TABLE I—Continued

Instrument and Photographic Laboratory.

- 1—6" lathe
- 1—7" shaper
- 1— $\frac{1}{2}$ " drill press
- 1—6 $\frac{1}{2}$ " bench milling machine
- 1—6" bench grinder
- 1—4" x 5" camera
- 1—4" x 5" enlarger
- 1—36" plate whirler
- 1—15" x 17" vacuum printing frame
- 1—6" x 30" printer
- 1—12" x 12" hot plate
- 1—4" x 5" camera rack
- 1—31" x 24" etching machine
- 1—Paint sprayer
- 1—Photographic print drier
- 1—Microscope with laboratory stand
- 1—20" print trimmer
- 4—Wratten safe lights
- 1—Sink with 4' drain board
- 6—Storage cabinets
- 1—Magnetic chuck
- 1—Dividing head
- 1—Stenciling machine

Blacksmith Shop.

- 2—Forges
- 2—Anvils
- 1—Bench grinder
- 1—Shop-made drill press
- 1—Carriage vise
- 1—Layout table
- 2—Portable acetylene torches
- 1— $1\frac{1}{2}$ -ton portable electric crane
- 1—Bench vise
- 1—Pneumatic forming press

Sheet Metal Shop.

- 1—10" bench grinder
- 1— $\frac{1}{2}$ " drill press
- 1—42" metal shear
- 1—6" metal shear
- 1—30" bending brake, 18-gage capacity
- 1—8' bending brake, 14-gage capacity
- 1—Power-driven forming roll
- 1—36" roll, 16-gage capacity
- 1—300-ampere electric welding machine

TABLE I—Continued

Sheet Metal Shop.—Continued.

- 1—Welding torch, acetylene
- 1— $\frac{1}{4}$ " portable electric drill
- 1—Portable electric metal shear, 18-gage capacity
- 1—Portable pneumatic metal shear, 18-gage capacity
- 1—Portable power hacksaw
- 1—Portable grinder, 6,000 r.p.m.
- 1—Portable grinder, 4,500 r.p.m.
- 1—Bench vise 6"
- 1—Anvil
- 1—Portable electric spot welder
- 1—44" x 18' steel layout bench

Battery Shop.

- 1—Motor-generator 0-30 amperes, 0-90 volts
- 1—Motor-generator 0-30 amperes, 140 volts
- 1—4" bench vise
- 1—Acetylene torch

Transformer Room.

- 1—Transformer test rack—shop-made

Paint Shop.

- 1—Air filter and regulator
- 3—Paint spray guns
- 1—Drying rack
- 1—Drying oven
- 1—Exhaust fan
- 1—Sink and drain board
- 2—Storage cabinets

Sand Blast House.

- 1—Sand blast, size 50" high, 37" wide, 72" long

Switch Repair.

- 1—12' electric test bench with 8' a.c. and d.c. test panel with voltmeters and ammeters; 1 rectifier with power stat voltage control, 1 small vise, and 3 tool drawers
- Portable meters: 1 industrial circuit tester; 1 a.c. voltmeter, 0-125 volt; 1 a.c. voltmeter 0-300 volt; 1 a.c. milliammeter 0-750; 1 ammeter 0-10 amperes; 1 meter, 0-15 amperes d.c. and 0-150 volts d.c.
- 1—500-volt insulation megger
- 1—250-volt test lamp; 1-coil former
- 1—Pneumatic test bench
- 1—3,500-pound dynamometer
- 1—Electric drill with stand
- 1—Steam cleaner

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TABLE 1—Continued

Relay Room.

- 1—Complete test set for 502A C.T.C.
- 1—Complete test set for 504C C.T.C.
- 1—Shop-made test panel for coded relays with electric-driven Veeder counter and motor-driven timer
- 1—Shop-made motor-driven coder with codes of 240, 190, 184, 178, 128, 123, 118 and 75
- 1—On time meter
- 1—0-20 voltmeter
- 1—0-150-1,500 milliammeter
- 1—Volt-ammeter 0-1.5-15-150 volts and 0-0.15-1.5-15 amperes
- 1—Coil winder with turn counter
- 1—7" oscilloscope
- 1—Audio oscillator 7-77,000 cycles
- 1—Weston Model 785 industrial circuit tester
- 2—Volt-ohm-milliammeter meters
- 1—1,000-cycle generator
- 2—Slide resistors for relay tests
- 1—Tube tester
- 1—Vacuum tube voltmeter
- 1—Decibel meter
- 1—0-200 watt-meter
- 1—Deep freeze box, 7.5 cu. ft.
- 1—Bridge for resistance, reactance and capacity, lab. type
- 1—Brush oscillograph
- 1—Floor type $\frac{1}{2}$ " vertical drill press
- 1—Paint booth with 2 guns
- 1—Shop-made test panel for d.c. or a.c. relays, consisting of:
 - 1—Weston Model 155 0-0.050 ampere
 - 1—Weston Model 155 0-0.150 ampere
 - 1—Weston Model 155 0-0.5 ampere
 - 1—Weston Model 155 0-1 ampere
 - 1—Weston Model 155 0-3 amperes
 - 2—G.E.Co. Model 330 0-125 volts
 - 1—Weston Model 1 0-150 volts
 - 1—Weston Model 1 0-0.5 ampere
 - 1—Weston Model 1 0-3,000 ohms
 - 1—Weston Model 1 0-100 ohms
- 1—10" buffer and grinder
- 5—3" bench vises
- 1—0-500 megger
- 5—Benches equipped and wired for a.c. and d.c. as follows:
 - 1—Potentiometer with slide
 - 1—Weston 0-15-150 voltmeter
 - 1—Weston 0-500-1,500 M.A. meter
 - 1—Synchrograph railway tester
 - 1—Square wave generator

Action Recommended
Acceptance as information.

COOPERATIVE REPORT

PURCHASES AND STORES DIVISION, A.A.R.
GENERAL RECLAMATION COMMITTEE*

P. P. Ash, Representative

The General Reclamation Committee has continued its efforts to find ways and means for economically reclaiming materials as well as bringing up-to-date previous Recommended Rules and Practices which will be issued in their consolidated Manual to be known as "A.A.R. Purchases and Stores Division Manual of Reclamation."

As to reclaiming items pertaining to the Signal Section the Committee will report on reclaiming insulated track fittings carrying out A.A.R. Signal Section Specification 216, Manual Part 116, pertaining to assembly and test of insulated track fittings and A.A.R. Signal Section Specification 13 on hard fibre, Manual Part 58.

Action Recommended

Acceptance as information.

* Previous report on this subject appears in A.A.R. Signal Section 1950 Proceedings, Vol. XLVIII, p. 236.

COMMITTEE IV—AUTOMATIC BLOCK SIGNALING

Personnel

E. N. Fox, Chairman
L. B. Yarbrough, Vice-Chairman

H. D. Abernethy	W. T. Lewis
C. M. Acker	P. H. Linderoth
R. B. Amsden	H. A. Maynard
J. A. Beoddy	C. F. Nelson
L. S. Bottinelli	S. E. Noble
F. L. Chatten	M. A. Otterbourg
W. L. Dayton	D. H. Steiner
J. R. Heisler	H. G. Stiebeling
H. Jensen	R. E. Taylor
A. L. Jordan	W. G. Trost
T. H. Kearton	W. L. Waleen

Signal Section, A.A.R.:

The following outline of work has been assigned:

1. Revision of Manual.
2. Indexing signal literature.
3. Report on protection against lightning.
4. Investigate and report on methods of improving shunting of track circuits.
5. Investigate and report on means and methods for the improvement of track circuit rail bonding used in signaling, collaborating with Committees I and V.
6. Investigate and report on the use of automatic block systems, with superimposed control.
7. Investigate and report on the use of track instruments instead of track circuits for the release of electric switch locks and electric locking.
8. Investigate and report on the use of high-voltage lightning arresters—various voltage ranges.
9. Investigate and report on the practicability of in-service tests of all types of lightning arresters.
10. Investigate and report on devices for sanding of rail, or equivalent, which will reduce track circuit shunt failures due to sand, collaborating with Mechanical Division, A.A.R.
11. Investigate and report on the various types of power for operating signaling systems and the operating cost therefor.
12. Performance specification for solderless type connectors for use in wiring signal apparatus (various size conductors).
13. Specification for screw locks and signal padlocks for outside use.
14. Requisites for discharge resistors.
15. Investigate and report on control and ignition for gas switch heaters.

The Committee submits for consideration, reports on the following subjects*:

1. Revision of Specification 83-44, Manual Part 164.
 3. Protection against lightning.
 4. Methods of improving shunting of track circuits.
 5. Performance tests on twist drills for bond holes.
 10. Devices for sanding of rail, or equivalent, which will reduce track circuit shunt failures due to sand.
 15. Electric control of gas switch heaters.
- Cooperative report. American Petroleum Institute Correlating Committee on Cathodic Protection.
- Cooperative report. Communications Section, A.A.R. Committee No. 7—Inductive Coordination.

Information

Specifications, etc., of other organizations referred to in the report of this Committee may be procured from the following:

A.S.A.—American Standards Association, 70 E. 45th St., New York 17, N. Y.
A.S.T.M.—American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.

Disposition of 1951 Letter Ballot Subjects

The following subjects presented by Committee IV at the 1951 Annual Meeting were submitted to letter ballot and officially approved:

- Specification 135-51—Track Circuit Bonding—Now in Manual Part 22.
Formulae for Computing Minimum Allowable Resistance Between Track Battery and Track and for Computing Related Current and Voltage Data—Now in Manual Part 132.
Requisites for Track Circuits—Now in Manual Part 59.
Requisites for Automatic Block Signaling Circuits—Now in Manual Part 34.
Instructions for Minimizing the Effect of Foreign Current on Direct Current Track Circuits—Now in Manual Part 127.
Requisites for Electric Locks Applied to Hand-Operated Switches for Protection of Main Track Movements—Now in Manual Part 211.
Specification 60-51—Installation of Made Ground—Now in Manual Part 92.
Specification 52-51—Low-Voltage Lightning Arresters—Now in Manual Part 95.

* Suggestions or criticisms should be submitted in writing to the Chairman of the Committee on or before September 1, 1952.

PERFORMANCE TESTS ON TWIST DRILLS FOR BOND HOLES

This is a report of a Member Road using twist drills, $\frac{3}{8}$ inch diameter, having a point angle of 118 degrees and lip clearance of 8 to 12 degrees in accordance with Specification 254, Manual Part 259, for drilling in head of rail. They were operated at 250 to 300 r.p.m. in accordance with Instructions for Operation of Power Machines and Drilling of Holes for Rail Bonding, Manual Part 260. The power machines were equipped with collet chucks.

Test No. 1 was conducted with new drills as furnished by manufacturer. The average number of holes per drill was satisfactory but effort was made to determine the cause of the wide variation between individual drills. Inspection of the drills after Test No. 1 showed the chisel edge had rounded over indicating hard spots in the rails, normal with high carbon content, and explains to some extent the variance in the number of holes per drill. Drills 1 and 22, which were removed because of drilling oversized holes, were found to have points slightly off center. All drills were then resharpened by manufacturer for Test No. 2.

The average number of holes per drill in Test No. 2 on the resharpened drills was unsatisfactory. Inspection of the drills after this run showed too much lip clearance and that the cutting edges were not equal in length. It showed chip wash on many of the drills extending all the way across one lip but only near the chisel point on the other cutting edge indicating the point was not central. It also showed a small amount of wear on the back taper due to previous runs.

On the second resharpening, which was also done by manufacturer, it was necessary to shorten the drill to a point where the drills once more had sufficient back taper of approximately 0.005 inch per inch of flute length. Some of the drills had to be shortened about $\frac{1}{4}$ inch to gain this end. On this resharpening, the clearance behind the cutting edge was made 6 to 8 degrees instead of the 8 to 12 degrees as used in Tests Nos. 1 and 2. The drills were carefully checked to insure the point was central and the cutting edges were of equal length. Results of Test No. 3 were very satisfactory.

The improved performance of Test No. 3 is mainly attributed to greater care being used in resharpening of the drills. The decreased lip clearance is not suspected of having considerable influence on the performance; however, the Committee has the matter under further investigation.

It is recommended that Member Roads give careful attention to resharpening and inspection of drills. It is further recommended in the interest of uniformity and better bonding that steps be taken to replace or change their drilling machines to use the collet chucks with Specification 254 drills and eventually make obsolete, drills with flatted and $\frac{3}{32}$ inch shanks.

Results of the tests are shown in Table I.

TABLE I

Drill No.*	Test No. 1	Test No. 2	Test No. 3
	NEW DRILLS Lip clearance 8-12 deg. Holes drilled	FIRST RESHARPENING Lip clearance 8-12 deg. Holes drilled	SECOND RESHARPENING Lip clearance 6-8 deg. Holes drilled
1	10 (a)	47 (c)	226
2	215 (b)	37 (c)	1 (a)
3	254 (b)	30 (c)	350
4	387 (c)	67 (c)	401
5	338 (c)	15 (c)	230
6	235 (b)	15 (c)	401
7	176 (c)	33 (c)	250
8	387 (c)	15 (c)	159
9	164 (c)	39 (c)	230
10	164 (d)	39 (c)	187
11	142 (c)	12 (a)	159
12	225 (e)	110 (c)	220
13	214 (b)	34 (c)	172
14	170 (b)	18 (b)	220
15	0 (f)	41 (b)	42 (e)
16	193 (b)	48 (c)	309
17	224 (e)	1 (a)	226
18	132 (b)	13 (c)	
19	226 (b)	69 (c)	175
20	80 (c)	10 (c)	375
21	33 (c)	64 (b)	172
22	33 (a)	33 (b)	250 (e)
23	175 (c)	46 (b)	309
24	47 (c)	72 (c)	175
25	211 (c)	15 (c)	187
26	211 (c)	47 (c)	375
27	186 (c)	25 (c)	350
28	250 (c)	25 (c)	
29	180 (c)		
30	226 (c)		
Average	189 (29 drills)	36 (28 drills)	237 (26 drills)

Notes:

*Drill numbers in Tests Nos. 2 and 3 correspond but not with Test No. 1.

(a) Replaced because drilling oversized holes.

(b) Replaced because dull and drilling oversized holes.

(c) Replaced because dull.

(d) Replaced because cutting hard and slipping in chuck.

(e) Replaced because machine slipped, breaking drill.

(f) Replaced because cutting point damaged.

Action Recommended

Acceptance as information.

ELECTRIC CONTROL OF GAS SWITCH HEATERS

Electric control, ignition and indication features of gas switch heaters is of considerable interest to the Signal Section because of the increased use of such heaters and the installation, maintenance and operation of the electrical features is generally a signal department responsibility.

The switch heaters under consideration as currently manufactured consist primarily of longitudinal gas burners in sections fixed in a parallel position along both sides of the switch for a length approximating the length of the movable switch points. The series of gas jet flames along the burners are directed along the rails to maintain a temperature in the metal switch structure and closely surrounding air which will melt snow and prevent formation of ice. The gas is supplied from fixed storage tanks or banks of replaceable cylinders, or from mains supplying natural or manufactured gas through a distributing piping system to the burners.

The original installations were generally made in yard or terminal areas, being grouped at locations where employees were in close attendance to observe the functioning of the heaters and prompt maintenance service was available. For these reasons the electrical features were of secondary importance to the operation.

Gas heaters have come into more general use in the past 4 or 5 years, an increased number being installed at remote locations. The electrical features have not been entirely satisfactory. They have required considerable experimenting and development by the railroads and manufacturers towards a more reliable and simpler system. Reports on newer types of electrical features indicate improved performance.

The installation of heaters on traffic control systems where it is desired to turn the heaters on and off at will and also indicate whether the heater is burning or not introduces the most exacting requirements for positive and dependable operation. The performance of the electrical features of these heaters should as near as possible approach the reliability of similar features of traffic control installations. Most remote control installations fall in this same category, particularly if no employees are in the vicinity of the installation to attend or observe and report operation.

The electrical requirements on these heater installations are primarily to open the fuel supply line by means of solenoid valve, ignition of the gas, discontinuance of the ignition current after the heaters are lighted, provision for reignition if the heaters are extinguished and indication that the heaters are burning or not.

At present, two manufacturers are offering heaters with these electrical features. In the past, alternating current operation has been the type most in demand apparently because this was the first type developed and the reluctance of the signal departments to control these heaters from their direct current signal power supply because of heavy current demands, unreliable operation, and apparatus and wiring installations not considered to be in accordance with usual railroad signal practices.

The individual railroad's requirements on the electrical features in the past, while probably necessary in the development stage, have led to numerous arrangements and voltages. Electrical operation is now being provided for

110 or 220 volts a.c. and for 6, 10, 12 and 32 volts d.c. It appears desirable for the manufacturers and the railroads to attempt to arrive at a more uniform arrangement.

One type of solenoid valve originally required 1.5 amperes at 12 volts continuously while the heater was turned on. This was objectionable for direct current sources and has been reduced to 0.33 to 0.5 ampere on more recent installations. Further reduction in current requirements has been obtained by use of a gas pressure switch in combination with the solenoid valve which inserts resistance in series with the solenoid when it has picked up.

The ignition of the gas is accomplished either by a hot wire coil or spark. The hot wire type has provided more reliable operation than the spark type. Condensation of moisture around the spark plug terminal and contacts has been troublesome.

Of the present hot wire igniters, one type has two coils in series, one for each switch rail heater requiring about 7.5 amperes at 12 volts. Another type has the hot coils in parallel, requiring 6 amperes at 6-10 volts. The resistance coils must heat to a temperature of about 1,200 degrees as the gas ignites at 1,000-1,100 degrees. Generally, 10 to 15 seconds operation of the ignition circuit is all that would be required but under adverse conditions it may require about 1 minute to ignite the gas.

In the hot wire type of ignition the current through the hot wire is controlled either by a thermal bimetallic contact attached to the heaters or by a sensitive relay operated from a thermo-couple. The thermo-couple is heated by a pilot light in the ignition housing while the bimetallic contact is heated by an inverted jet of flame from the heater. The hot wire ignition is placed in operation either by a gas pressure switch or circuits through the relay controlling the solenoid valve.

In one type of hot wire ignition the heaters are protected against momentary outages by the use of a coil of iron wire which is kept at white heat by an inverted jet of flame. On outages of an appreciable length of time the bimetallic contact closes and the hot wire coil reignites the gas.

In other types of hot wire ignition the protection against outages is by means of a pilot light burning continuously while the heater is on. On outage of both the heater flames and pilot light the thermal-couple relay de-energizes and the hot wire coil reignites the gas.

The spark type ignition has a spark plug for each heater assembly. The spark plug is fired either by high tension coil or a magneto. In one method, the spark plug is fired by a high tension coil operated from a battery source. The spark is interrupted by an associated electronic timer in cycles of approximately 5 seconds on and 25 seconds off, continuing the cycling operation while the heater is on. The spark ignition apparatus is placed in operation by a pressure switch when the solenoid valve releases the gas into the piping system.

For another method, the spark plug is similarly fired by high tension coil but uses a thermal bimetallic contact on the heater to control the spark. With this type the spark is on only for approximately 10 to 15 seconds or until the gas ignites and causes the thermal bimetallic contact to open. In event of a momentary outage of the heater gas flame, it is reignited immediately by a coil of iron wire which is kept at white heat by an inverted gas flame jet from the heater, which flame is also used in the operation of the bimetallic contact. A gas pressure switch is also used to place this type in operation.

An experimental gas-operated spark igniter has been in use. It uses a magneto instead of a source of battery and a short-time spark is produced every 5 or 6 seconds. When the solenoid is operated to release the gas into the piping system a small portion is diverted through a gas-pressure operated mechanism to drive the magneto as long as the heater is on.

For indication principle, one type has a thermal bimetallic contacting arrangement, one on each switch rail heater under the control of the burner flame. Contacts open to cut off the ignition current and to provide an indication control. Another type provides the same features by means of a thermo-couple under the control of the pilot light for each switch rail heater. The current produced by the thermo-couple operates sensitive relays which in turn cut off the ignition circuit and provide a means for indicating.

The indication of the heaters being lighted for their full length can be made more positive by adding more thermo-couples or thermal bimetallic contacts, or a combination of the two. Some consideration has been given to detection of the heater in operation along each switch rail to be sure it is burning at both ends and in the middle, which to a reasonable degree, guarantees the functioning of the heater for its full length.

Substantial progress has been made by the manufacturers working with individual railroads to improve the operation and dependability of these features; however, the Committee believes other improvements are needed, as follows:

1. In some instances where means are not available to insure a stand-by gas supply, a pressure switch may be necessary to prevent closing of the solenoid valve or ignition circuits unless there is gas to light.
2. Solenoid valve should preferably be made to operate on 8 to 12 volts d.c. at about 0.3 to 0.5 ampere with provisions that when the valve is open the current demand be reduced not to exceed 0.050 to 0.100 ampere or less if possible.
3. Ignition should preferably be by hot wire coils either in series or parallel to operate over an 8 to 12 volt d.c. range with a 6 to 7.5 ampere load for not to exceed 1 minute. Consideration should be given to providing a thermal relay to automatically turn off the ignition current after 1 minute which would stay off until reset by turning the control off and then establishing it again.
4. Ignition circuit should be under control of pilot or burner flame so that reignition will be automatic if burner goes out, providing the control is on and the thermal relay has not shut off the ignition circuit.
5. Reliable and positive indication is very desirable on remote locations because if the heater does not light, the operator must find other means of keeping switches open on short notice.
6. Where vaporizer burners are used on fixed storage tank installations to secure adequate gas pressure from smaller tanks, consideration should be given to providing an indication of the vaporizer pilot light separate from the indication on the switch heater as it is essential that the vaporizer burner operate.
7. The Committee believes that the basic electrical features should be designed for the reliable service demanded by the operation of traffic control systems; however, a simpler arrangement may be used for yard or terminal installations, omitting the indicating features, etc.

Action Recommended

Acceptance as information.

METHODS OF IMPROVING SHUNTING OF TRACK CIRCUITS

Modification of rail head surface by welding stainless steel, bronze or other metal on surface of the head of rail.

At the 1946 Annual Meeting* the Committee reported on tests to improve the shunting sensitivity of track circuits on Railroad P by modification of the rail head surface. The original test installation on main track of 18-8 stainless steel weld metal deposited on top of the rails about $\frac{1}{2}$ inch from gage side by electric welding in 1942 is still in service except where a few rails have been changed out. There has been no spalling out of the stainless steel and the shunting sensitivity of the track circuits remains satisfactory after approximately 10 years of service with average movements of eight engines and two transfers of 30 to 40 cars each per day. The later installations of bronze welding composition used for welding bronze, brass and copper, applied in the same manner as the stainless steel, on infrequently used turnouts are expected to last much longer because of the smaller number of train movements.

Another railroad in October 1948 modified the rail head surface of a little used crossover in a remote-controlled interlocking to insure proper functioning of the detector locking. Stainless steel beads were deposited by electric welding on top of the rails about $\frac{1}{2}$ inch from gage side. These beads were approximately $\frac{1}{8}$ inch in height and 4 inches long with a space of approximately 2 inches between beads. A $\frac{1}{32}$ inch 18-8 316 MO titantic type stainless steel electrode was used. The composition of this electrode consisted of 18 parts chrome, 8 parts nickel, 2 parts molybdenum and small portions of other materials. The crossover is being used an average of six times per day. A recent examination of the beads determined that the wear has been so little in 3 years that these beads are expected to insure satisfactory shunting sensitivity for at least 12 years more, provided the traffic remains approximately the same.

Shunting problem imposed by operation of single unit self-propelled cars equipped with disc brakes.

Single unit self-propelled rail cars equipped with disc brakes are being operated over track circuits in automatic signal, interlocking and traffic control territories on several railroads. It is expected that the use of these cars will be extended because of the operating economies which may be effected thereby. Because these cars are being operated as single units and the wheels may not always be as bright and clean as when clasp-type brakes are used, the shunting of the track circuits may not be reliable, especially when there is frost, snow or moisture on the rails and sand is picked up on the tread of the wheels. A number of cases have been reported in which highway grade crossing protection operated with the car moving away from the crossing due to momentary loss of shunt when passing from the approach to the center track circuit at the crossing, resulting in a loss of the directional feature. Gate tower indicators have cleared and dropped as the car was passing from one track circuit to another. Momentary loss of detector locking at interlockings has occurred due to the leaving track relay picking up before the entering track circuit was

* A.A.R. Signal Section 1945 Proceedings, Vol. XLIII, p. 95.

shunted, particularly at higher speeds. An automatic signal has been known to clear behind the car while it was standing at a station due to automatic application of sand.

The Committee is giving consideration to tests and means for improving the performance of signal facilities where these cars are being operated as single units at various speeds under various weather and temperature conditions. Tests made by some of the railroads with recording instruments and the continuous check of shunting sensitivity on the control machine in traffic control territories has determined that one car may operate the signal facilities satisfactorily when equipped with shoes of proper material and design at proper pressure and position to maintain clean wheels and break through accumulated wheel film while another car, which is apparently identical, causes intermittent failures which require that special precautions be taken. Investigations have been made to determine what the difference in the two cars might be but to date no difference in the physical arrangement of the cars has been found. Experience has determined that the periodic check of a car in any circuit or number of circuits is not conclusive evidence due to the fact that shunting irregularities might occur on one track circuit at one time while in another instance operation in this circuit would be satisfactory with shunting irregularities occurring elsewhere. Therefore, it does not appear that great reliance can be placed on periodic tests with a recording instrument.

Methods under consideration to assist in improving shunting of track circuits for operation of single unit self-propelled cars equipped with disc brakes:

1. Revision of track circuits to provide increased shunting sensitivity.
2. Stagger of insulated joints to be kept at a minimum stagger distance.
3. Mechanical department to maintain wheel cleaning and sanding facilities on these cars in proper condition.
4. Special precautions to be taken in the use of sand or when sand is applied in making a stop.
5. Special operating instructions to be issued for operation on secondary track or branch line equipped with signal facilities where traffic density is light.

It is not yet known whether or not these methods will provide adequate protection, especially at higher speeds.

The Committee will collaborate with the Mechanical Division and the manufacturers of these cars to investigate and report on methods and devices to improve shunting of track circuits.

Full-wave rectified a.c. track circuits for classification yards.

Shunting sensitivity tests which the Committee made on the Pennsylvania R. R. at White Valley, Pa., on October 18 and 25, 1937 to improve shunting of lightweight equipment of the passenger or freight carrying type demonstrated that the rectified a.c.-d.c. track circuit with a full-wave rectifier at the relay and with added resistance between the rectifier and track produced excellent results.

Subsequent tests have demonstrated the superior shunting ability of the rectified alternating current types of track circuits over the conventional types of alternating current track circuits under rail surface conditions adverse to

shunting. The rectified alternating current track circuit may not show any great improvement over the direct current track circuit energized from a 2-volt storage cell under direct shunt obtained by connecting a known resistance from rail to rail but when properly adjusted it provides much greater shunting sensitivity under the rolling shunt test. A rolling shunt is one of variable or intermittent value similar to that obtained when a car is moving over track with rusty or dirty rail surfaces. Rolling shunt tests may be made on track circuits in service by using a clean, plain or galvanized, round iron bar 1 inch or larger in diameter and 6 to 8 feet long rolled slowly along the surface of the two rails and noting its effect on shunting of the track relay.

Sensitive fast shunting is necessary on short track circuits protecting switches in a classification yard equipped with car retarders, as shunting must be effected by a single car. Experience has determined that inter-rail voltages of 6 to 8 volts will provide much greater shunting sensitivity than the usual 2 volts or less.

When alternating current is used, it is easy to obtain 6, 8 or 10 volts, as desired, from the secondary of the track transformer. These alternating current voltages have peak values 1.41 times that read by the voltmeter and these peak values aid in breaking down the rust film.

For detection purposes, the speed of shunting is important. The signal companies have determined that a special direct current track relay, in which the operating current is the same as that of a conventional 4-ohm track relay (0.070 ampere) but in which series resistance has been added in the relay coils to bring the relay resistance up to 28.5 ohms, will shunt in 0.05 second or less when used with 6 to 8 volts on the track circuit described in the foregoing.

The minimum ballast resistance is assumed to be not less than 2 ohms per 1,000 feet or 36 ohms total for a 55-foot track circuit. The resistance of leads to track usually should not exceed 0.2 ohm. With a 16-ohm adjustable resistor between the full-wave rectifier and track and with the secondary voltage of the transformer set at 9 volts, the 16-ohm resistor may be adjusted to provide 6 to 8 volts between rails with 0.170 to 0.175 ampere to the 28.5-ohm relay in the tower with maximum lead resistance of 7 ohms between rectifier and relay. The current to track will not exceed 3.5 amperes under car shunt.

Action Recommended

Acceptance as information.

**DEVICES FOR SANDING OF RAIL, OR EQUIVALENT, WHICH WILL
REDUCE TRACK CIRCUIT SHUNT FAILURES DUE TO SAND***

The report of the Committee's investigation, in collaboration with representatives of the Mechanical Division, A.A.R., of devices for sanding of rail, or equivalent, which will reduce track circuit shunt failures due to sand contained the recommendation that the Specification for Locomotive Sanding System in the A.A.R. Mechanical Division Manual of Recommended Practice be revised and brought up-to-date and that a specification for locomotive sand be included, to avoid excessive build-up of sand on the rails.

Considering that the desired results are effective sanding for traction and braking without sufficient sand build-up on the rails under any condition to cause a false signal indication, the first approach of a Subcommittee of the Mechanical Division Committee on Locomotive Construction was a study of the pattern of the sand delivery obtained with the several sizes of sand pipes and diameters of converging nozzles commonly used. Sand traps from three manufacturers were used in the tests and the tests were of sufficient breadth to develop that the pattern of delivery for a given pipe or nozzle size remains approximately the same through the range of delivery rate that may be used.

The Committee on Locomotive Construction reviewed and revised the Mechanical Division's recommended sanding practice for steam, Diesel-electric and electric locomotives, and the Committee on Specifications for Materials prepared a new specification for car and locomotive sand, as follows:

LOCOMOTIVE SANDING SYSTEM**Steam Locomotives**

Sand pipes to be of 1 inch extra heavy pipe.

Rate of sand delivery per sand pipe per minute:

Engine having one sand delivery per rail, 3 pounds maximum.

Engine having two sand deliveries per rail, $1\frac{1}{4}$ pounds maximum.

Engine having three or more sand deliveries per rail, 1 pound maximum.

Sand pipe or nozzle to be positioned to deliver the sand to the rail over an area 3 inches to 5 inches ahead of wheel contact with rail through to the point of contact. The delivery to be angled slightly inwardly to make maximum contact on the inner half of the rail face having the protection of the wheel flange to reduce the loss.

On drivers equipped with lateral motion device, or lateral cushioning device, sand pipes should be provided with flexible arrangement so that sand pipes can follow drivers when taking curves.

Diesel Locomotives

Sand pipes to be of 1 inch extra heavy pipe.

Rate of sand delivery 1 pound per minute per sand pipe.

* Previous reports on this subject appear in A.A.R. Signal Section 1947 Proceedings, Vol. XLV, pp. 130 and 441 and A.A.R. Signal Section 1949 Proceedings, Vol. XLVII, pp. 120 and 288.

With the sand pipe or nozzle delivery position changing from that when sanding for traction in the brake release position to that when sanding during brake application with fully worn brake shoes, extreme care must be exercised in the application of the sand pipe to provide effective sanding for traction and braking. The sand delivery should be into the wheel contact at rail when brakes are set and with fully worn shoes. This results in delivery over an area 3 inches to 5 inches ahead of wheel contact for traction. The high velocity obtained with the $\frac{5}{8}$ inch or $\frac{1}{2}$ inch converged nozzles results in a more effective rail conditioning and positive delivery of sand.

Electric Locomotives

Sand pipes to be 1 inch extra heavy pipe.

Rate of sand delivery 1 pound per minute per sand pipe.

Diagrams showing recommended sand pipe locations are included in the recommended practice.

SPECIFICATIONS

M-916-51

CAR AND LOCOMOTIVE SAND

1. *Scope.*—These specifications cover a clean sharp silica sand free from clay, loam, mica, and other foreign material, for use in car and locomotive sanding equipment.

Chemical Requirements

2. The solubility of 100 grams of sand immersed in 150 cc. of concentrated hydrochloric acid for 24 hours shall not exceed 5 per cent.

3. *Alternate Method for Determination of Silica in High Silica (90 per cent Minimum) Locomotive Sand.*

(a) Fifteen to twenty grams of the representative sample is ground to pass a 200 mesh sieve.

(b) A one-gram sample is weighed in a tared platinum crucible and heated to a temperature of approximately 1,500 deg. F. for one-half hour. It is then cooled and re-weighed. The loss in weight times 100 gives the percentage of material lost on ignition.

(c) To the weighed residue in the crucible add 4 drops of distilled water, 2 drops concentrated sulphuric acid (1.84 specific gravity) and 10-15 cubic centimeters of pure hydrofluoric acid and then evaporate to dryness. The crucible is then rotated carefully, using crucible tongs, over an open gas flame to avoid splattering until all sulfur trioxide fumes have been expelled, after which the crucible is blasted for a minute, cooled and re-weighed. The loss in weight times 100 gives the per cent of silica in the sand.

(d) For sands containing less than 90 per cent of silica, the usual chemical fusion method should be used for the silica determination.

Physical Requirements

4. *Caking Test.*—The sand shall have satisfactory non-caking properties as determined by the following test: A cylinder not less than 11 inches high and 1 inch in diameter shall be filled with the sand after the sand has been saturated with distilled water. After drying in an oven at 100 deg. C. for 12 hours, it shall run freely through an opening of $\frac{1}{2}$ inch in the bottom of the container without shaking or tapping.

5. *Grading.*—The sand shall meet the following grading requirements:

	Min.	Max.
Percentage passing U.S. Standard Sieve No. 10.....	100	—
Percentage passing U.S. Standard Sieve No. 30.....	40	—
Percentage passing U.S. Standard Sieve No. 50.....	10	30
Percentage passing U.S. Standard Sieve No. 80.....	—	5

6. *Sampling.*—A 25-pound sample representing each carload may be taken either at destination or at the plant.

Inspection and Rejection

7. *Inspection.*

(a) The inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the material ordered. The manufacturer shall afford the inspector, free of charge, all reasonable facilities and necessary assistance to satisfy him that the material is being furnished in accordance with these specifications. Tests and inspection at the place of manufacture shall be made prior to shipment unless otherwise specified.

(b) The purchaser may make tests to govern the acceptance or rejection of the material in his own laboratory or elsewhere. Such tests shall be made at the expense of the purchaser.

8. *Rejection.*

(a) Material represented by samples which fail to conform to the requirements of these specifications will be rejected.

(b) Material which shows injurious defects subsequent to its original inspection and acceptance at the manufacturer's works, or elsewhere, will be rejected, and the manufacturer shall be notified.

9. *Rehearing.*

(a) Samples tested in accordance with these specifications which represent rejected material, shall be held for a period of 14 days from date of the test report. In case of dissatisfaction with the results of the tests, the manufacturer may make claim for a rehearing within that time.

The above recommendations for sanding practice and sand were accepted for submission to letter ballot at the 1951 Annual Meeting of the Mechanical Division, A.A.R. on June 26-28, 1951. The recommendations subsequently received letter ballot approval of the members and are now a part of the recommended practice of the Mechanical Division.

It is the opinion of Signal Section Committee IV that any complaints regarding excessive sand build-up on rails may be corrected by the exercise of reasonable care regarding a fair quality of sand preferably to the coarse side of the sieve range; sand pipes or nozzles of diameter to provide a high velocity delivery; positioning of delivery nozzles to insure effective delivery of sand to point of wheel-rail contact; and maintenance of sand trap adjustment to approximately the recommended delivery rates.

Action Recommended

Acceptance as information.

(Revision of A.A.R. Signal Section Specification 83-44)
A.A.R. SIGNAL SECTION SPECIFICATION 83-52.

TRANSFORMER, DRY-TYPE SELF-COOLED

1. *Purpose.*

(a) This specification is for the purpose of providing for a dry-type single-phase transformer up to 660 volts, cooled by natural circulation of air. It sets forth specific detail requirements representing modern signal practice recommended for new installations and for replacement on existing installations when general renewal or replacement becomes desirable.

2. *Requisites, specifications, standards and drawings.*

(a) Requisites, specifications, standards and drawings referred to in the body of this specification form an essential part hereof.

(b) Manufacturer shall furnish with his tender, drawings forming an essential part thereof.

3. *Tender.*

(a) The tender shall be for a product meeting the requirements of this specification in its entirety.

4. *Purchaser's order requirements.*

(a) The following additional requirements will be shown on the Purchaser's order:

1. Total kv-a. rating.
2. Frequency.
3. Primary voltage.
4. Number of secondaries and purpose of each.
5. Output in volts and amperes and power factor of each secondary.
6. Total voltage of each secondary and tap voltages, if any.
7. Indoor or outdoor service.
8. Wall, shelf, or cross-arm mounting.
9. Service conditions, if outside the limits shown in section 7-a.
10. Inspection and tests as required.
11. Alternate requisites as required.

5. *Alternates.*

(a) The provisions contained in the alternate requisites section of this specification form a part hereof only when substituted by Purchaser's order for the provisions contained in this specification.

6. *Material and workmanship.*

(a) Material and workmanship shall be first-class in every respect.

7. *Service conditions.*

(a) Equipment conforming to this specification shall be suitable for operation at its rating provided that:

1. The temperature of the cooling air (ambient temperature) does not exceed 104 deg. F. and the average temperature of the cooling air for any 24-hour period does not exceed 86 deg. F.
2. The altitude does not exceed 3,300 ft.

8. *Type.*

(a) Transformer shall be designed for indoor or outdoor service, as specified.

(b) Transformer shall be designed for cross-arm, wall or shelf mounting, as specified.

9. *Windings.*

(a) Track, lighting and rectifier transformers shall have their primaries wound for 57.5 volts or even multiples thereof up to 575 volts. The voltage and frequency shall be specified. The primary shall have a 13 per cent tap to compensate for reduced voltage.

(b) Insulating and line transformers shall have primary wound for voltage and frequency specified.

(c) Line transformers shall be provided with percentage taps to compensate for reduced voltage if and as specified.

(d) Compensating taps shall be for full rated kv-a.

(e) The number of secondaries, their purpose, voltage taps, v.a. rating and power factor of each shall be as specified.

(f) Voltages specified shall be based on full-load operation at the power factor specified.

(g) All windings shall be insulated from each other.

10. *Rating.*

(a) Transformer shall have a continuous kv-a. rating equal to the sum of the ratings of all the secondaries.

11. *Frequency.*

(a) Transformer shall be designed for the frequency specified.

12. *Core.*

(a) The core shall be non-aging laminated sheet steel so assembled that no buzzing is perceptible.

(b) The steel shall be considered non-aging provided the percentage change in core loss does not exceed 2 per cent after subjecting the steel to a continuous temperature of 212 deg. F. for a period of 30 days.

13. *Insulation.*

(a) Windings shall be wound with one of the following types of insulated wire and treated so as not to be injuriously affected

13. *Insulation.*—Continued.

by atmospheric conditions or by changes in temperatures between 40 deg. F. below zero and 185 deg. F. above zero. *R-13-a.

1. Cotton-covered wire shall be in accordance with Specification 194, Manual Part 189.

2. Enameled wire shall be in accordance with Specification 193, Manual Part 183, and shall have an additional covering consisting of a layer of cotton, silk or equivalent.

(b) Windings shall be impregnated by vacuum and pressure with insulating compound in accordance with Requisites for Compound for Impregnation of Electrical Windings, Manual Part 171. *R-13-b.

(c) Insulating material used for fillers in winding shall be chemically neutral.

(d) Material used for insulation shall be such that in the completed transformer it will not be injuriously affected by atmospheric conditions.

14. *Leads and terminals.*

(a) Transformers for outdoor service shall be provided with leads of insulated flexible copper wire. Primary leads shall project not less than 36 in. and secondary leads not less than 12 in. beyond the housing of transformer. They shall be of a cross-section not less than that of the winding to which they connect, and in no case less than No. 14 A.W.G. They shall be so secured as to prevent strain coming on the connections to coils.

(b) Transformers for indoor service shall be provided with terminal boards made of molded insulation, ebony asbestos wood or other equally suitable material of thickness sufficient to prevent warping or damage in shipment. Terminal boards shall be so located as to be easily accessible.

1. Leads from windings rated 175 volts or less shall be brought to binding posts uniformly arranged on the terminal board.

2. Leads from windings rated more than 175 volts shall be not smaller than No. 14 A.W.G. flexible insulated wire and brought through the terminal board or housing and so secured as to prevent strain coming on the connections to windings, except that for windings not exceeding 250 volts the leads may be brought to binding posts on the terminal board. When used, leads shall project not less than 12 in. beyond terminal board or housing and shall be provided with suitable connectors to permit ready connection and taping of joint. *R-14-b-2.

(c) On transformers having exposed leads between winding and terminal board, if the winding conductor is of smaller cross-

* Alternate requisites section.

14. *Leads and terminals.*—Continued.

section than No. 14 A.W.G., a flexible conductor of not less than No. 16 A.W.G. conductivity shall be used.

(d) On totally enclosed transformers for indoor service where winding conductor is of smaller cross-section than No. 18 A.W.G. a flexible conductor of a conductivity of not less than No. 18 A.W.G. shall be used between winding and binding post.

(e) Binding posts, nuts and washers shall conform to Drawing 1070, assembly 107010.

(f) Binding posts shall be mounted so they cannot be turned in the base or frame to which applied. They shall be properly insulated from each other and other metallic parts.

15. *Polarity of windings.*

(a) The instantaneous external polarities of windings shall be indicated by plainly marking the relative positive and negative leads from each winding. They shall be determined as follows:

1. The positive terminal of the primary winding shall be arbitrarily indicated.
2. The positive terminal of a secondary winding will then be that terminal from which current is flowing out to the load at the instant when current is flowing into the positive terminal of the primary winding.

(b) All transformers of a given type and manufacture shall be so arranged that the instantaneous polarities of corresponding leads are alike.

16. *Name plate and diagram.*

(a) A name plate shall be securely fastened to each transformer and shall give the following information:

1. Name and address of Manufacturer.
2. Total kv-a. rating.
3. Frequency.
4. Primary voltage.
5. Total voltage of each secondary winding.
6. Serial number.
7. Manufacturer's reference number.

(b) Information showing the ampere capacity of each secondary, the full-load voltage and tap voltages of each winding and the relative instantaneous polarities of the leads shall be shown on a diagram or tag attached to each transformer, or, where practicable, this information may be marked on terminal board.

17. *Housing.*

(a) Housings for transformers for outdoor service shall be weather-resisting and so designed as to afford moisture and mechanical protection to the windings.

18. *Dielectric requirements.*

(a) Assembled transformer shall withstand for 1 minute a 60-cycle insulation test, at place of manufacture, of 3,000 volts between each winding and other metallic parts insulated therefrom, except where specified otherwise.

(b) Transformer winding rated more than 175 volts shall withstand for 1 minute a 60-cycle insulation test at place of manufacture of 10,000 volts between such winding and other metallic parts insulated therefrom, except that windings rated more than 175 volts but less than 250 volts may, when designed to be connected to a local line or load, be tested to withstand 3,000 volts.
*R-18-b.

(c) When a secondary has an associated adjusting secondary, the insulation between them shall withstand for 1 minute a 60-cycle insulation test, at place of manufacture, of 500 volts.

(d) A surface leakage distance sufficient to withstand dielectric tests in sections 18-a and b shall be provided between any exposed metallic part of the apparatus carrying current and any other metallic part thereof. Surface leakage distance shall be not less than $\frac{3}{8}$ in.

(e) A potential of twice the normal operating requirements at a suitable frequency shall be impressed across the windings for 1 minute, without any excessive flow of current indicating a short circuit.

19. *Tests.*

(a) Tests may be made at point of production, or on samples submitted, and may also be made at destination.

(b) Manufacturer shall give the Purchaser sufficient notice of time when the material or product will be ready for testing.

(c) Manufacturer shall provide, at point of production, apparatus and labor for making required tests under supervision of the Purchaser.

(d) If tests are to be made at point of production, it shall be so stated on Purchaser's order. The Purchaser shall indicate which of the tests herein specified are to be made and what portion of the material or product shall be tested.

(e) The following tests may be required by Purchaser on all transformers:

1. Exciting current.
2. No-load voltage ratio.
3. Polarity.
4. Dielectric strength.
5. No-load loss.

(f) Unless otherwise specified, the following tests† shall not be required when a record of tests made on two transformers, dupli-

* Alternate requisites section.

† Charge may be made for these tests.

19. *Tests.*—Continued.

cates or essentially duplicates of the type and rating specified can be furnished:

1. Regulation.
2. Temperature rise.
3. Load losses.
4. Full-load voltage ratio.

20. *Description of tests.*

(a) Exciting current.

1. The average exciting current shall not exceed the following percentage of full-load current:

V.A. rating	25-cycle	60-cycle	100-cycle
Up to 100.....	25	15	12
101 to 200.....	15	10	10
Over 200.....	10	10	10

(b) No-load voltage ratio.

1. This test shall be made with rated voltage applied to primary and with secondaries on open circuit.

(c) Full-load voltage ratio.

1. The full-load voltage ratio of the transformer shall be checked by impressing the rated voltage and frequency on the primary winding and reading all secondary voltages with all secondaries delivering their rated load at specified power factor. The value obtained shall not vary more than 2 per cent, plus or minus, from the values given on the voltage diagram and Purchaser's order.

(d) Polarity.

1. Polarity of all transformers shall be checked as follows:

(a) Connect the indicated positive terminal of one winding to the indicated negative terminal of another winding until all the windings are in series, impressing the rated voltage across the terminals of the primary winding. The voltmeter connected between the two ends of all the windings in the series shall read the sum of all their voltages.

(e) Dielectric strength.

1. Tests shall be made in accordance with sections 18-a, b, c and e.

(f) No-load losses.

1. No-load losses and exciting current shall be taken at any convenient ambient air temperature, preferably not less than 59 deg. F.

2. No-load losses shall be measured with watt-meter at normal frequency and voltage using power from generator giving sine wave, where such is available. When a pure sine

20. *Description of tests.*—Continued.

wave is not available it shall be permissible to use any wave form which comes within the A.S.A. definition of sine wave, adjusting the voltage so that the no-load losses will be the same as with normal voltage and sine wave.

3. Where voltage cannot be regulated by excitation of the generator it shall be done with auto-transformer and not by rheostat in series with the transformer to be tested. The average of the no-load losses of the transformers tested shall not exceed the value specified in section 20-h and the maximum no-losses shall in no case exceed the value given in section 20-h by more than 10 per cent.

(g) Load losses.

1. Load losses shall be determined by watt-meter in accordance with A.S.A. Standard for load losses and the average of the load losses of the transformers tested shall not exceed the value specified in section 20-h and the maximum load losses shall in no case exceed by more than 10 per cent the specified values given in section 20-h.

(h) No-load and load losses.

1. The no-load and load losses shall not exceed the figures shown in the following table except as provided in sections 20-f and g:

V.A. rating	No-load losses, per cent	Load losses, per cent	Total losses, per cent
Up to 50.....	6	14	20
51 to 200.....	5	10	15
201 to 500.....	4	8	12
501 to 1,000.....	2½	5½	8
Over 1 kv-a.....	2	4	6

(i) Regulation.

1. With no load the voltage of each of the windings shall not exceed the unity power factor load values specified by more than 10 per cent. This test shall be made at any convenient temperature and corrected to a reference temperature of 167 deg. F.

2. When calculated, the regulation for either the whole or part of the transformer shall be computed from measured resistance and the reactance drop of voltage using the method as given in the A.S.A. Standards.

(j) Temperature rise.

1. Two transformers of each new design shall be tested for temperature rise.

2. When tested for temperature rise, transformers may be overloaded and over-excited to hasten the rise of temperature to the ultimate value under normal load, and final temperature in any part maintained for 1 hour under con-

20. *Description of tests.*—Continued.

stant full load and normal voltage and frequency shall not exceed the temperature of the room more than 99 deg. F. The rise of temperature shall be determined by the increase of resistance of the windings by the methods given in A.S.A. Standards and shall be checked by thermometer placed as directed by representative of Purchaser.

21. *Inspection.*

(a) Purchaser may inspect the material or product at all stages of manufacture.

(b) Purchaser may inspect the completed product to determine that the requirements of this specification have been met.

(c) If product has not been accepted at point of production and if, upon arrival at destination, it does not meet the requirements of this specification, it may be rejected, and the Manufacturer, upon request, shall advise the Purchaser what disposition is to be made of the rejected product. Manufacturer shall pay all freight charges.

(d) If Purchaser is to make inspection at point of production it shall be so stated on Purchaser's order.

22. *Packing.*

(a) Product shall be so assembled or packed as to permit convenient handling and to protect against loss or damage during shipment.

23. *Marking.*

(a) Purchaser's order, requisition and package number, name of Consignor, and name and address of Consignee, shall be plainly marked on outside of packages.

(b) Detail list of packages and their contents shall be furnished for each shipment. Where carload shipments are made, routing and car identification shall be shown.

24. *Warranty.*

(a) Manufacturer shall warrant the product covered by this specification to be free from defects in material and workmanship under ordinary use and service, his obligation under this warranty being limited to manufacturing, at point of production, any part or parts to replace those which shall be found defective within 1 year after shipment to the Purchaser. This warranty shall not apply to any product which shall have been repaired or altered in any way by anyone other than the Manufacturer thereof, so as to affect, in the Manufacturer's judgment, its proper functioning or reliability, or which has been subjected to misuse, negligence or accident.

Alternate requisites.

R-13-a.

Windings shall be wound with one of the following types of insulated wire and treated so as not to be injuriously affected by atmospheric conditions or by changes in temperatures between 40 deg. F. below zero and 185 deg. F. above zero:

1. Enameled wire shall be in accordance with Specification 193, Manual Part 183.
2. Wire covered with.....insulation.

R-13-b.

Windings shall be impregnated by vacuum and pressure with insulating varnish in accordance with Requisites for Varnish for Treatment of Electrical Windings, Manual Part 174.

R-14-b-2.

Leads from windings rated volts or less shall be brought to binding posts uniformly arranged on the terminal board.

R-18-b.

Transformer winding rated more than volts and not exceeding volts shall withstand for 1 minute a 60-cycle insulation test at place of manufacture of volts a.c. between such winding and other metallic parts insulated therefrom.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Specification 83-44—Transformer, Dry Type, Self-Cooled,
Manual Part 164.

PROTECTION AGAINST LIGHTNING*

Previous reports on this subject have emphasized that the use of discharge resistors represents the best method of inter-connecting the lightning arrester ground system with the track.

A careful reconsideration of the replies to questionnaire (Inquiry SS-85A), referred to on page 143 of A.A.R. Signal Section 1949 Proceedings, Vol. XLVII, indicates an extensive use of low-voltage arresters that are in accordance with Specification 52, Manual Part 95, rather than discharge resistors for this purpose.

Obviously, the successful use of the low-voltage arresters indicates that there are many locations where a lesser degree of protection than would be obtained with discharge resistors is practical.

The Committee at this time presents revised Fig. 1, but wishes to direct attention to the following limitations:

Conventional signal arresters when used as track arresters may not be satisfactory because they do not pass surge currents until spark-over occurs at the gap and since simultaneous spark-over probably will not occur in each arrester, a surge voltage may occur between rails and across the track circuit apparatus.

These arresters are not designed for a discharge capacity which will carry the sum of the currents which may sometimes occur when several signal arresters and primary arresters discharge their combined lightning and power-follow current to the track rails.

* Previous report on this subject appears in A.A.R. Signal Section 1949 Proceedings, Vol. XLVII, pp. 142 and 290.

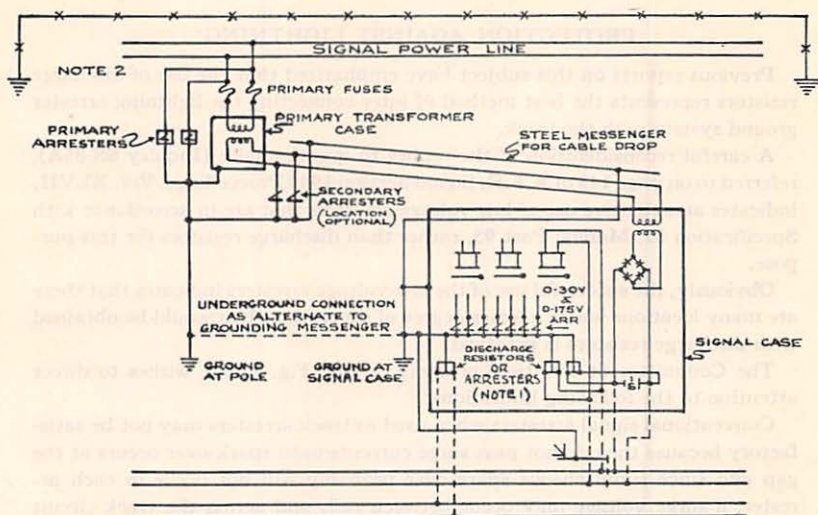


FIG. 1

—x—x—x— = OVERHEAD GROUND WIRE EXTENDING SEVERAL POLES
EITHER SIDE OF TRANSFORMER LOCATION

Notes for Fig. 1.—

1. (a) Discharge resistors as shown should be used to give the most effective protection. They must have an inverse resistance-current characteristic so that they will not pass an appreciable amount of current at signal voltages but will pass large amounts of lightning discharge currents with relatively low IR drop.

1. (b) Where a maximum degree of protection is not required, low-voltage arresters which are in accordance with Specification 52, Manual Part 95, may be used in place of discharge resistors. They must be installed between each rail lead and the common ground bus.

2. Overhead ground wire extending several poles either side of transformer location. Overhead ground wire or shield should have 8 feet or more vertical clearance from all power and signal wires. Down leads from shield wire should have 4 feet 3 inches or more clearance from all other wires and the grounds should not be closer than 10 feet to any other ground or buried conductor. Net resistance of the shield wire grounds in multiple should not exceed 4 ohms.

3. Additional protective devices may be required, depending upon the types of circuits and apparatus employed. For example, an arrester is frequently connected as a shunt across track leads as additional protection for track circuit apparatus.

Action Recommended

Acceptance as information.

COOPERATIVE REPORT

AMERICAN PETROLEUM INSTITUTE
CORRELATING COMMITTEE ON CATHODIC PROTECTION

R. B. Amsden, Representative

A. B. Armistead, Alternate

In the 1951 Annual Meeting Advance Notice*, a progress report outlined the activities of the Correlating Committee on Cathodic Protection, in which representatives of 10 national industry organizations and an engineering association have cooperated, under sponsorship of the American Petroleum Institute, to prepare and disseminate information about cathodic protection of buried metallic structures, its beneficial use and the necessity for cooperation in dealing with it to avoid stray current interferences with neighboring structures.

Four bulletins which were drafted by the Correlating Committee on Cathodic Protection and released between February 1948 and March 1951 have been consolidated and edited to minimize duplications. The consolidated booklet, entitled "Cathodic Protection—Report of Correlating Committee on Cathodic Protection" was published in October 1951 and has been given fairly wide initial distribution. Copies of this report may be obtained at nominal cost by application to the National Association of Corrosion Engineers, Room 919, Milam Building, Houston, Tex.

Action Recommended

Acceptance as information.

COOPERATIVE REPORT

COMMUNICATIONS SECTION, A.A.R.
COMMITTEE NO. 7—INDUCTIVE COORDINATION†

E. N. Fox, Consulting Member

The following report of interest to the Signal Section was presented at the 1951 Annual Meeting of the Communications Section, A.A.R. and accepted as information by that Section:

TRANSPPOSITIONS IN SIGNAL SUPPLY CIRCUITS

A-1. The committee finds that there is no uniformity of practice in the application of transpositions to alternating current signal supply circuits on pole lines used jointly with communication circuits.

* A.A.R. Signal Section 1950 Proceedings, Vol. XLVIII, pp. 179 and 385.

† Previous report on this subject appears in A.A.R. Signal Section 1949 Proceedings, Vol. XLVII, pp. 152 and 293.

A-2. On some railroads, no transpositions are used. On others, they are used to a degree which varies between wide limits and may not be the same on various parts of the same railroad. On other railroads, transpositions are installed only when the need for them has become apparent. It is extremely difficult to determine when transpositions are needed, as alternating current signal supply circuits are usually completed in small increments and the inductive effects are then cumulative over a period of time and not readily identified.

A-3. It is the recommendation of the committee that transpositions be installed on new construction, major rearrangements, or extension of existing a-c signal supply circuits.

A-4. Where signal supply circuits are located on the communication pole line, either above the communication circuits, or below, on the end pins of a communication-type crossarm, these transpositions should be located as follows:

(a) For E-sections, at the odd $\frac{1}{8}$ ths of the communication transposition scheme.

(b) For L-sections at the odd $\frac{1}{4}$ ths.

(c) For U-sections: None for a single U-section. When there is a series of consecutive U-sections, one supply circuit transposition located at a US pole, approximately at the center of this series of consecutive U-sections.

A-5. Major discontinuities in the signal supply circuit should in general occur at balance points in the communication transposition scheme. When this is impractical, special transpositions in the supply circuit should be installed so as to secure adequate balance between the supply and communication circuits.

A-6. Major discontinuities in the supply circuit are: The power feed point, change in pin position of the supply circuit, change in crossarm spacing, between signal and communication arm, of one gain or more.

A-7. Minor discontinuities which do not have to be taken into account are: Load transformers, disconnecting switches, and end of supply circuit.

A-8. Transpositions in the signal supply circuit may be running transpositions.

A-9. Where signal supply circuits are located on pole line on opposite side of track, in general, no transpositions are necessary in the supply circuit.

Note: Certain types of a-c track circuits require that proper polarity (phasing) of the a-c be maintained at the signal locations. In such cases, when adding transpositions to the supply circuit, this phasing should be checked and corrected if necessary.

A-10. In special cases, where local conditions require, additional transpositions in the signal supply circuit may be found necessary to control existing interference.

B—Coded Track Circuits

B-1. There are certain types of "coded track circuits" in which the current in the track circuit (the two rails) is interrupted at various frequencies. Usually two codes are used: 75 and 180 per minute, representing two respective signal indications. When there is a train in the circuit, short-circuiting the rails, this track current rises to fairly sizable value, and has been known to cause noise interference in paralleling telephone circuits. Such interference has been, and usually can be, taken care of by adding spark-killers to the signal code transmitting relays and it is the recommendation of this committee that it be taken care of in this manner by the Signal Department or Signal Manufacturer.

Action Recommended

Acceptance as information.

COMMITTEE V—CONTRACTS AND INSTRUCTIONS

Personnel

E. B. Platt, Chairman

F. Youngwerth, Vice-Chairman

W. Abell	A. T. Hunot
G. D. Booth	J. G. Karlet
L. C. Brown	F. M. Kunker
W. N. Donahue	C. L. Ott
R. C. Dueland	J. A. Phillips
A. C. Eastman	E. L. Rogers
O. Falkenstein	G. C. Schindler
E. W. Hastings	W. L. Scott
I. D. Hesler	S. P. Searle

Signal Section, A.A.R.:

The following outline of work has been assigned:

1. Revision of Manual.
2. Indexing signal literature.
3. Instructions for testing signal installations before placing in service.
4. Instructions for electric locks applied to hand-operated switches.
5. Forms for reporting progress of the component parts of new signal installations and expenditures for labor.
6. Investigate and report on a simplified system of numbering and identification of wires and circuits which does not require the changing of nomenclature and tags on wayside circuits when a minor change is made.
7. Investigate and report on the use of portable induction type telephones by signal forces.
8. Specification covering an instrument for determining ground resistance.
9. Recommend uniform practice in reporting track circuit rail bond failures under I.C.C. classifications, collaborating with Committees I and IV.

The Committee submits for consideration, reports on the following subjects*:

1. Revision of Definitions for Technical Terms Used in Signaling, Manual Part 55.
- Revision of Specification 112-46, Manual Part 3.
- Revision of Instructions for Resistance of Made Grounds, Manual Part 61.
- Revision of Specification 85-46, Manual Part 168.
- Revision of Specification 115-46, Manual Part 169.
- Revision and Consolidation of Instructions for Non-Coded Direct Current Track Circuits, Instructions for Non-Coded Alternating Current Track Circuits, and Instructions for Coded Direct Current Track Circuits, Manual Parts 8, 162 and 218.

* Suggestions or criticisms should be submitted in writing to the Chairman of the Committee on or before September 1, 1952.

Revision of Instructions for Copper-Oxide Caustic Soda Primary Cells, Manual Part 7.

Revision of Instructions for Car Retarder Systems, Manual Part 125.

Revision of Instructions for Insulation Resistance, Manual Part 130.

Revision of Instructions for Facing Point Locks Applied to Spring Switches, Manual Part 159.

4. Instructions for Electric Switch Locks.

6. Simplified system of numbering and identification of wires and circuits which does not require the changing of nomenclature and tags on wayside circuits when a minor change is made.

Cooperative report. American Standards Association—Definitions of Electrical Terms—Project C42—Subgroup 8.

Information

Specifications, etc., of other organizations referred to in the report of this Committee may be procured from the following:

A.I.E.E.—American Institute of Electrical Engineers, 33 W. 39th St., New York 18, N. Y.

A.S.A.—American Standards Association, 70 E. 45th St., New York 17, N. Y.

Disposition of 1951 Letter Ballot Subjects

The following subjects presented by Committee V at the 1951 Annual Meeting were submitted to letter ballot and officially approved:

Definitions for Technical Terms Used in Signaling—Now in Manual Part 55.

Specification 257-51—Ground Resistance Testing Instrument—Now in Manual Part 103.

Instructions for Automatic Block Signal Systems—Now in Manual Part 102.

Instructions for Interlockings—Now in Manual Part 59.

Instructions for Signal Protection for Movable Bridges—Now in Manual Part 233.

Instructions for Light and Semaphore Signals—Now in Manual Part 54.

Instructions for Time Releases Applied to Signal Apparatus—Now in Manual Part 128.

Instructions for Switch Circuit Controllers—Now in Manual Part 134.

Instructions for Electric Locking—Now in Manual Part 199.

(Revision of Definitions for Technical Terms Used in Signaling)
A.A.R. SIGNAL SECTION DEFINITIONS.

TECHNICAL TERMS USED IN SIGNALING

1952

Back Light, Highway Crossing Signal. (Revision of "Back Light")

An auxiliary signal light used for indication in a direction opposite to that provided by the main unit.

Back Light, Signal. (New)

The light from a signal electric lamp visible through a small opening in the back of a light signal, used for checking the operation of the signal lamp.

Battery, Floating. (Revision)

A storage battery which is kept in operating condition by a continuous charge at a low rate or primary battery coupled with a rectifier to provide a supplementary source of energy.

Bond, Impedance. (Revision)

An iron core coil of low resistance and relatively high reactance, used on electrified railroads to provide a continuous path for the return propulsion current around insulated joints and to confine the alternating current signaling energy to its own track circuit.

Brake Shoe, Retarder. (New)

See definition for Shoe, Brake; Retarder.

Car Retarder System. (New)

A system designed to control car movements comprising car retarders together with such yard switch machines, skate machines, hump signals, and trimmer signals as may be required and necessary control facilities.

Classification Yard. (New)

See definition for Yard, Classification.

Controller, Hump Signal. (New)

A device located at the hump which includes the hump signal control lever and may also include the trimmer signal control lever and signal repeater lights.

Device, Focusing. (Revision)

An instrument used to locate the filament of an electric lamp at proper focal point of lens or reflector systems.

Filter, Wave. (New)

A device for separating waves on the basis of their frequency. It introduces relatively small insertion loss to waves in one or more frequency bands and relatively large insertion loss to waves of other frequency.

Filter, Electric Wave. (New)

A wave filter designed to separate electric waves of different frequencies.

Filter, Low Pass. (New)

A wave filter having a single transmission band extending from zero frequency up to some critical or cut-off frequency, not infinite. (A.I.E.E.)

Filter, High Pass. (New)

A wave filter having a single transmission band extending from some critical or cut-off frequency, not zero, up to infinite frequency. (A.I.E.E.)

Filter, Band Pass. (New)

A wave filter which has a single transmission band, in which the critical or cut-off frequencies are neither zero nor infinite.

Filter, Band Elimination. (New)

A wave filter which has a single attenuation band, in which the critical or cut-off frequencies are neither zero nor infinite.

Filter, Direct Current and Voice Pass. (New)

A low pass filter that passes direct current and voice frequencies and attenuates the frequencies above the voice range.

Filter, Low Pass Code. (New)

A low pass filter connected between coding equipment and line to pass direct current code impulses and prevent code equipment from shunting carrier and communication circuits. It prevents line coding contacts from introducing undesired high frequency currents into the line.

Filter, Direct Current, Voice and Type H Pass. (New)

A low pass filter that passes direct current, voice frequencies and Type H carrier frequencies, and attenuates frequencies above the Type H range.

Filter, Code. (New)

See definition for Filter, Low Pass Code.

Filter, Voice and Carrier Pass. (New)

A high pass filter that passes voice frequencies and carrier frequencies and attenuates frequencies below the voice range.

Filter, Voice and Type C Pass. (New)

A band pass filter that passes voice and Type C carrier frequencies and attenuates frequencies below the voice range and above the Type C range.

Filter, Voice Pass. (New)

A band pass filter that passes voice frequencies and attenuates frequencies above and below the voice range.

Filter, Voice and Type H Pass. (New)

A band pass filter that passes voice and Type H carrier frequencies and attenuates frequencies below the voice range and above the Type H range.

Filter, Receiving. (New)

A band pass filter associated with the input circuit of a carrier receiver or repeater.

Filter, Transmitting. (New)

A band pass filter associated with the output circuit of a carrier transmitter or repeater.

Hump. (Revision)

See definition for Yard, Hump.

Hump Signal. (New)

See definition for Signal, Hump.

Hump Signal Controller. (New)

See definition for Controller, Hump Signal.

Machine, Control; Car Retarder System. (New)

See definition for Machine, Control.

Machine, Skate. (New)

A mechanism electrically controlled and electrically or pneumatically operated, for placing a skate on, or removing it from, the rail.

Machine, Switch; Yard. (New)

A quick acting device electrically controlled and electrically or pneumatically operated, for positioning track switch points, and so arranged that accidental trailing of the switch points does not cause damage.

Receiver, Carrier. (New)

An electronic device for receiving predetermined carrier frequencies and converting them to suitable form for operation of associated devices.

Repeater, Carrier. (New)

An electronic device inserted in a carrier circuit, usually to amplify carrier voltages to compensate for losses occurring in transmission.

Retarder Shoe. (New)

See definition for Shoe, Brake; Retarder.

Shoe, Brake; Retarder. (New)

The expendable wearing part of a car retarder for applying braking pressure to car wheels.

Shoe, Retarder. (New)

See definition for Shoe, Brake; Retarder.

Signal, Flashing Light. (Revision)

A highway crossing signal, the indication of which is given by two horizontal red lights flashing alternately at predetermined intervals or a fixed signal in which the aspects are given by color and by the flashing of one or more of the signal lights.

Signal, Four-Position. (Revision)

A light signal unit arranged to provide four aspects.

Signal, Highway Crossing. (Revision)

An electrically operated signal used for the protection of highway traffic at railroad-highway grade crossings.

Signal, Hump. (New)

A signal located at the summit in a hump yard which gives indication concerning movement to the classification tracks and indicates to the engineman the desired direction and speed of movement of his train.

Signal, Three-Position. (Revision)

A semaphore arm or a light signal unit arranged to provide three aspects.

Signal, Trimmer. (New)

A signal located at the summit in a hump yard, which gives indication concerning movements from the classification tracks toward the summit.

Signal, Two-Position. (Revision)

A semaphore arm or a light signal unit arranged to provide two aspects.

Skate. (New)

A sliding device placed on a rail to engage with a car wheel so as to provide continuous braking by sliding friction.

Skate Machine. (New)

See definition for Machine, Skate.

Switch Machine, Yard. (New)

See definition for Machine, Switch; Yard.

Switching, Automatic. (New)

A term generally used to describe a system of controls for the automatic operation of track switches whereby routes that are established by a preliminary manual selection are automatically completed by the progress of cars or trains.

Terminal, Carrier. (New)

A group of carrier apparatus at the initiating or terminating end of a carrier system.

Transmitter, Carrier. (New)

An electronic device for generating predetermined carrier frequencies.

Transformer, Impulse. (New)

A transformer whose primary is connected in series with a direct current code line circuit and whose secondary actuates a device, usually a polar relay, in response to changes of the code line current.

Transformer, Matching. (New)

A transformer to match the impedance of the open line wire to the cable (or vice versa) where the line circuit is carrier over both open line wires and cable having different characteristic impedances.

Trimmer Signal. (New)

See definition for Signal, Trimmer.

Unit, Application; Control Office. (New)

A group of relays and circuits in a code system which in conjunction with the control levers forms the control code characters, and which stores the information received from indication codes.

Unit, Auxiliary Line. (New)

See definition for Unit, Code Converter.

Unit, Code Converter. (New)

A group of relays and circuits used in conjunction with field carrier apparatus for conversion and coordination between a carrier circuit and a remotely controlled direct current line.

Unit, Field Application. (New)

A group of relays and circuits in a code system which applies control code information to the proper function control relays and assists in the transmission of indication codes.

Unit, Field Line Coding. (New)

See definition for Unit, Field Stepper.

Unit, Field Stepper. (New)

A group of relays and circuits in a code system that receives and interprets the control codes and generates indication codes from the field to the office.

Unit, Field Storage. (New)

See definition for Unit, Field Application.

Unit, Master; Control Office. (New)

A group of relays and circuits in a code system that generates the control codes and receives and interprets the indication codes.

Unit, Office Line Coding. (New)

See definition for Unit, Master; Control Office.

Unit, Office Storage. (New)

See definition for Unit, Application; Control Office.

Unit, Remote Line. (New)

See definition for Unit, Code Converter.

Unit, Telephone Coupling Capacitor. (New)

A device consisting of high-voltage capacitors, inserted between telephone and line, to prevent faults that may occur in the telephone apparatus and wiring from affecting direct current codes on the line.

Unit, Telephone Coupling Reactor. (New)

A device to prevent faults that may occur in the telephone apparatus and wiring from causing excessive loss to carrier frequencies where telephones are coupled to a code line.

Yard, Classification. (New)

A yard in which cars are classified or grouped in accordance with requirements. (A.R.E.A.)

Yard, Hump. (Revision)

A railroad classification yard in which the classification of cars is accomplished by pushing them over a summit, known as a hump, beyond which they run by gravity.

Action Recommended

Acceptance for submission to letter ballot.

(Revision of A.A.R. Signal Section Specification 112-46)
A.A.R. SIGNAL SECTION SPECIFICATION 112-52.

PORTABLE ALTERNATING CURRENT AMMETER

1. *Purpose.*

(a) This specification is for the purpose of providing for a portable alternating current ammeter for use on circuits not having d.c. components.

2. *Tender.*

(a) The tender shall be for a product meeting the requirements of this specification in its entirety.

3. *Purchaser's order requirements.*

(a) The following additional requirements will be shown on the Purchaser's order:

1. Class of instrument as specified in section 5-b.
2. Range of instrument as specified in section 6-a.
3. Carrying case when required.
4. Inspection and tests as required.

4. *Material and workmanship.*

(a) Material and workmanship shall be first-class in every respect.

5. *Design.*

(a) Instrument shall be self-contained of a design acceptable to the Purchaser.

(b) Instruments shall be of two general classes:

1. Those having a 4 in. minimum scale length for use when a relatively high degree of accuracy is desired.
2. Those having a $2\frac{1}{2}$ in. minimum scale length for use when a less accurate reading is acceptable.

6. *Ranges and scales.*

(a) Ranges and scales shall be as follows:

Single Range

Item	Range	Minimum length of upper arc, in.	Divisions*	No. of blocks*	Divisions per block*
1	0-150 milliamperes	4	150	15	10
2	0-150 milliamperes	$2\frac{1}{2}$	75	$7\frac{1}{2}$	10
3	0-500 milliamperes	4	100	10	10
4	0-500 milliamperes	$2\frac{1}{2}$	50	5	10
5	0-2 amperes	4	100	10	10
6	0-2 amperes	$2\frac{1}{2}$	50	5	10

* Scale divisions and blocks to conform to values specified as far as practicable.

6. *Ranges and scales.*—Continued.

Single Range—Continued

Item	Range	Minimum length of upper arc, in.	Divisions*	No. of blocks*	Divisions per block*
7	0-5 amperes	4	100	10	10
8	0-5 amperes	2½	50	5	10
9	0-15 amperes	4	150	15	10
10	0-15 amperes	2½	75	7½	10
11	0-50 amperes	4	100	10	10
12	0-100 amperes	4	100	10	10

Multi Range

13	0-250 milliamperes	4	125	12½	10
	0-500 milliamperes		100	10	10
14	0-1.5 amperes	4	150	15	10
	0-7.5 amperes				
	0-15 amperes				

* Scale divisions and blocks to conform to values specified as far as practicable.

(b) The figures used for the numbering of scales shall be legible and as large as practicable.

(c) Scales shall not be affected by moisture or changes in temperature.

7. *Binding posts.*

(a) Connections to instrument shall be made on binding posts.

(b) Binding posts shall be mounted so they cannot be turned in the base or frame to which applied. They shall be properly insulated from each other and other metallic parts.

(c) Binding posts need not be marked in single range or multiple range instruments employing a selector switch, but the common post on the multiple range instruments with separate binding posts for each range shall be marked with plus and minus ($\pm$) mark. The other posts on multiple range instruments shall be marked to correspond with the respective ranges.

(d) Binding post nuts shall be so designed that they will not come off in normal use.

(e) Binding post nuts shall be insulated.

8. *Zero corrector.*

(a) An external zero corrector shall be provided on each instrument.

9. *Pointer.*

(a) Pointer shall be the knife-edge type.

10. *Mirror.*

(a) Scale of instruments shall be provided with mirror directly under knife-edge of the pointer.

11. *Moving element.*

(a) The moving element shall turn on hardened accurately ground and highly polished steel or equivalent pivots, bearing on highly polished first-quality sapphires or equivalent jewels. The moving element shall respond quickly to changes in current and shall have a damping factor of not less than three.

12. *Heating.*

(a) Instruments shall not over-heat or show an appreciable error, when left in the circuit indefinitely at full load.

13. *Case.*

(a) Instrument cases shall be constructed with close fitting joints to minimize the entrance of dust and moisture, and shall have a neat and durable finish.

14. *Sealing.*

(a) Instruments shall be sealed to prevent any changes or adjustments except by means of the zero corrector.

15. *Impedance.*

(a) Single and double range instruments.

1. The impedance at from 25 to 100 cycles of instruments with 15 ampere range or less shall be such that full scale deflection will be produced by not more than 3 volt-amperes.

2. The impedance at from 25 to 100 cycles of instruments with 50 ampere range shall be such that full scale deflection will be produced by not more than 5 volt-amperes.

3. The impedance at from 25 to 100 cycles of instruments with 100 ampere range shall be such that full scale deflection will be produced by not more than 7.5 volt-amperes.

(b) Multi range instruments.

1. The impedance at from 25 to 100 cycles shall be such that full scale deflection will be produced by not more than 6 volt-amperes.

16. *Accuracy.*

(a) Instruments having a 4 in. minimum scale shall be accurate within plus or minus 0.75 per cent of full scale deflection at 77 deg. F. at 60 cycles a.c.

(b) Instruments having a 2½ in. minimum scale shall be accurate within plus or minus 1 per cent of full scale deflection at 77 deg. F. at 60 cycles a.c.

(c) This accuracy shall apply only throughout the upper two-thirds of the scale length.

17. Errors due to temperature and frequency.**(a) Temperature error.**

1. Instruments having a 4 in. minimum scale shall not have a temperature error exceeding 0.2 per cent of the indicated value for a change of plus or minus 10 deg. F. Instruments shall be adjusted for 77 deg. F. at 60 cycles a.c.

2. Instruments having a $2\frac{1}{2}$ in. minimum scale shall not have a temperature error exceeding 0.3 per cent of the indicated value for a change of plus or minus 10 deg. F. Instruments shall be adjusted for 77 deg. F. at 60 cycles a.c.

(b) Frequency error.

1. Instruments having a 4 in. minimum scale shall not have a frequency error exceeding 0.5 per cent of the indicated value when used over a range from 25 to 100 cycles. Instruments shall be adjusted for use on 60 cycles a.c.

2. Instruments having a $2\frac{1}{2}$ in. minimum scale shall not have a frequency error exceeding 0.5 per cent of the indicated value when used over a range from 25 to 100 cycles. Instruments shall be adjusted for use on 60 cycles a.c.

18. Data for reference.

(a) Instruments of the non-transformer type shall have the approximate inductance at 60 cycles and the approximate resistance plainly and permanently marked either on the face of the instrument or on a certificate or marking plate permanently attached to the instrument.

(b) Instruments of the transformer type shall have the effective resistance and impedance at 25 and 100 cycles plainly and permanently marked either on the face of the instrument or on a certificate or marking plate permanently attached to the instrument. When the impedance is practically constant from 25 to 100 cycles, only one value need be shown and it shall be marked 25-100 cycles.

19. Name plate.

(a) Name plate showing Manufacturer's name, model and serial numbers shall be attached to each instrument unless this information is shown on dial.

20. Dielectric requirements.

(a) The instrument assembled shall withstand for 1 minute an insulation test, at place of manufacture, of 2,600 volts a.c. between all parts of electric circuits and other metallic parts insulated therefrom.

21. Finish.

(a) Metal parts shall be protected against corrosion except where such protection will interfere with the proper functioning of that part.

21. *Finish.*—Continued.

(b) Material used for protection against corrosion shall neither melt nor flake under atmospheric conditions between temperatures of 40 deg. F. below zero and 185 deg. F. above zero.

22. *Inspection.*

(a) Purchaser may inspect the completed product to determine that the requirements of this specification have been met.

(b) If product has not been accepted at point of production and if, upon arrival at destination, it does not meet the requirements of this specification, it may be rejected, and the Manufacturer, upon request, shall advise the Purchaser what disposition is to be made of the rejected product. Manufacturer shall pay all shipping charges.

(c) If Purchaser is to make inspection at point of production it shall be so stated on Purchaser's order.

23. *Packing.*

(a) Product shall be so assembled or packed as to permit convenient handling and to protect against loss or damage during shipment.

24. *Marking.*

(a) Purchaser's order, requisition and package number, name of Consignor, and name and address of Consignee, shall be plainly marked on outside of package.

25. *Warranty.*

(a) Manufacturer shall warrant the product covered by this specification to be free from defects in material and workmanship under ordinary use and service, his obligation under this warranty being limited to manufacturing, at point of production, any part or parts to replace those which shall be found defective within 1 year after shipment to the Purchaser. This warranty shall not apply to any product which shall have been repaired or altered in any way, by anyone other than the Manufacturer thereof, so as to affect, in the Manufacturer's judgment, its proper functioning or reliability, or which has been subjected to misuse, negligence or accident.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Specification 112-46—Portable Alternating Current Ammeter, Manual Part 3.

(Revision of Instructions for Resistance of Made Grounds)
A.A.R. SIGNAL SECTION INSTRUCTIONS.

MADE GROUNDS*

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These instructions apply to the installation, maintenance and tests of made grounds. They set forth general requirements representing recommended practice.

1. Tests shall be made as instructed to determine the resistance between ground rod and surrounding earth. This resistance should preferably not exceed 15 ohms.

2. If the preferred resistance cannot be obtained by driving a single ground rod, multiple ground rods, or sectional ground rods, the soil should be treated by digging a circular trench 15 inches wide, 18 inches deep, and 48 inches in outside diameter around each rod; distribute 50 to 75 pounds of rock salt, depending upon soil resistivity, in trench; flood trench with water two or three times and then replace the soil in trench.

3. Where arrester location is on top of fill and desired resistance of ground is not obtained at the arrester location, supplementary ground rod or rods may be driven at the foot of the slope where good soil exists, or ground rods may be driven under the track at an angle of about 45 degrees, observing maintenance-of-way requirements. In such cases the ground rod at the arrester location must be maintained.

4. An approved instrument meeting the requirements of Specification 257, Manual Part 103, or equivalent, should be used. Manufacturer's instructions for using the instrument must be followed.

5. Wire connection between the single or multiple ground rods and the lightning arresters shall consist of a soft-drawn copper wire, size not smaller than No. 6 A.W.G., which shall be run as directly as practicable, avoiding acute angles, and must have sufficient slack to avoid breakage from the effects of frost.

6. Air space of not less than $\frac{3}{8}$ inch, or equivalent insulation, shall be maintained between wire connection and operating circuits.

7. Wire connection to ground shall conform to Drawing 1424.

8. Ground rod shall be located as close as practicable to lightning arresters, but not less than 3 feet from post, pole or foundation. Where space is not available to drive ground rod vertically, the rod may be at an angle so that the lower end is more than 3 feet from post, pole or foundation.

9. Ground rod shall be driven into the ground at least 8 feet wherever practicable.

* The term "as instructed" as used herein refers to individual railroad instructions.

10. Where multiple ground rods are used, they shall be placed at least 6 feet apart.

11. Results of inspections and tests herein required and all other inspections and tests that may be required must be recorded as instructed.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Instructions for Resistance of Made Grounds, Manual Part 61.

(Revision of A.A.R. Signal Section Specification 85-46)
A.A.R. SIGNAL SECTION SPECIFICATION 85-52.

PORTABLE DIRECT CURRENT VOLTMETERS,
AMMETERS AND VOLT-AMMETERS

1. *Purpose.*

(a) This specification is for the purpose of providing for portable direct current voltmeters, ammeters and volt-ammeters.

2. *Tender.*

(a) The tender shall be for a product meeting the requirements of this specification in its entirety.

3. *Purchaser's order requirements.*

(a) The following additional requirements will be shown on the Purchaser's order:

1. Type of instrument.
2. Class of instrument as specified in section 6-b.
3. Range combinations as specified in section 7-a.
4. Push button, fuses and selector switch when required.
5. Carrying case when required.
6. Inspection and tests as required.
7. Alternate requisites as required.

4. *Alternates.*

(a) The provisions contained in the alternate requisites section of this specification form a part hereof only when substituted by Purchaser's order for the provisions contained in this specification.

5. *Material and workmanship.*

(a) Material and workmanship shall be first-class in every respect.

6. *Design.*

(a) Instruments shall be self-contained of a design acceptable to the Purchaser.

(b) Instruments shall be of two general classes:

1. Those having a 4 in. minimum scale length for use when a relatively high degree of accuracy is desired.
2. Those having a $2\frac{1}{2}$ in. minimum scale length for use when a less accurate reading is acceptable.

7. *Ranges.*

(a) Ranges shall be as follows (†R-7-a):

1. Voltmeter shall be made with five ranges: 150—75—30—3—1.5.
2. Ammeter shall be made with six ranges: 30—15—3—1.5—0.15—0.030.
3. Volt-ammeter shall be made with one of the following four range combinations, as specified by the Purchaser:

Voltage ranges	Ampere ranges
30—3—1.5	3—0.3—0.03
30—3—1.5	30—3—0.3
150—30—3	15—1.5—0.15
150—15—3	15—1.5—0.15

8. *Scales.*

(a) Scales shall not be affected by moisture or changes in temperature.

(b) Length and division of scales shall be as follows:

Minimum length of scale, in.	Divisions	No. of blocks	Divisions per block
4	120 to 150	12 to 15	10
2½	75 or 60*	5 or 6*	15 or 10*

* Depending on combination of ranges selected.

(c) Scale length shall be measured along the upper arc.

(d) The figures used for the numbering of scales shall be legible and as large as practicable.

(e) A block may consist of 10 or 15 divisions and each block of the scale for voltmeters, ammeters, and volt-ammeters shall be clearly marked to show the reading values at these points, corresponding with the ranges contained in the instrument. On all scales having 15 divisions per block, the main block shall consist of three smaller blocks of 5 divisions with the cardinal lines of equal length.

9. *Binding posts.*

(a) Connections to instrument shall be made on binding posts.

(b) Binding posts shall be mounted so they cannot be turned in the base or frame to which applied. They shall be properly insulated from each other and other metallic parts.

(c) Binding posts shall be plainly marked:

1. Positive post with a plus (+) mark.

2. Other posts with respective ranges except on volt-ammeters with a range selector switch on which the other ammeter post is marked "Amps.," and the other voltmeter post is marked "Volts."

† Alternate requisites section.

9. *Binding posts.*—Continued.

- (d) Binding post nuts shall be so designed that they will not come off in normal use.
- (e) Binding post nuts shall be insulated.

10. *Range selecting switch.*

- (a) Where range selecting switch is used, the switch positions shall be plainly and permanently marked to correspond with the ranges as connected.
- (b) The "off" position of the switch shall be suitably marked and shall be located midway between the voltage and ampere ranges.
- (c) Ranges shall be so connected to the switch that the ampere ranges will be grouped on one side and the voltage ranges on the opposite side and both groups graduated from highest to lowest ranges with the highest range adjacent to the "off" position of the switch.

11. *Fuses.*

- (a) Where fuses are provided:
 - 1. They shall be clearly and permanently marked for the purpose intended.
 - 2. Means shall be provided in each instrument for carrying at least two spare renewal fuses for each purpose intended.
 - 3. They shall be accurately calibrated so that they will not appreciably affect the accuracy of the ranges in which they are to be used.
 - 4. They shall be so located as to permit ready access for changing fuses without disturbing the seal.
 - 5. Fuse clips shall be clearly and permanently labeled to correspond with the purpose intended.

12. *Zero corrector.*

- (a) An external zero corrector shall be provided on each instrument.

13. *Pointer.*

- (a) Pointer shall be the knife-edge type.

14. *Mirror.*

- (a) Scale of instruments shall be provided with mirror directly under knife-edge of the pointer.

15. *Moving element.*

- (a) The moving element shall turn on hardened accurately ground and highly polished steel or equivalent pivots, bearing on highly polished first-quality sapphires or equivalent jewels. The moving element shall respond quickly to changes in current and shall have a damping factor of not less than three.

16. *Shielding.*

(a) Instruments shall be shielded from magnetic influences caused, for example, by setting the instrument on a steel plate or surface.

17. *Push button.*

(a) Where a push button is provided in the voltage circuit it shall be so arranged that it can be locked in the depressed position.

18. *Heating.*

(a) Instruments shall not over-heat or show an appreciable error, when left in the circuit indefinitely at full load.

19. *Case.*

(a) Instrument case shall be constructed with close fitting joints to minimize the entrance of dust and moisture and shall have a neat and durable finish.

20. *Sealing.*

(a) Instruments shall be sealed to prevent any changes or adjustments except by means of the zero corrector.

21. *Current loss.*

(a) Current losses for voltage ranges shall be as follows:

1. Instruments having a minimum scale length of 4 in., not less than 1,000 ohms per volt for voltmeters, and 100 ohms per volt for volt-ammeters.

2. Instruments having a minimum scale length of $2\frac{1}{2}$ in., not less than 100 ohms per volt.

22. *Accuracy.*

(a) Instruments having a 4 in. minimum scale shall be accurate within plus or minus 0.5 per cent of full scale deflection at 77 deg. F.

(b) Instruments having a $2\frac{1}{2}$ in. minimum scale shall be accurate within plus or minus 1 per cent of full scale deflection at 77 deg. F.

23. *Error due to temperature.*

(a) Instruments having a 4 in. minimum scale shall not have a temperature error exceeding 0.5 per cent of the indicated value for a change of plus or minus 10 deg. F. Instruments shall be adjusted for 77 deg. F.

(b) Instruments having a $2\frac{1}{2}$ in. minimum scale shall not have a temperature error exceeding 1 per cent of the indicated value for a change of plus or minus 10 deg. F. Instruments shall be adjusted for 77 deg. F.

24. *Data for reference.*

(a) Instruments shall have the resistance of voltmeter ranges plainly and permanently marked either on the face of the instrument or on a certificate or marking plate permanently attached to the instrument. The resistance may be expressed, as, for example, "100 ohms per volt."

25. *Name plate.*

(a) Name plate showing Manufacturer's name, model and serial numbers shall be attached to each instrument unless this information is shown on dial.

26. *Dielectric requirements.*

(a) Instrument assembled shall withstand for 1 minute an insulation test, at place of manufacture, of 2,600 volts a.c. between all parts of electric circuits and other metallic parts insulated therefrom.

27. *Finish.*

(a) Metal parts shall be protected against corrosion except where such protection will interfere with the proper functioning of that part.

(b) Material used for protection against corrosion shall neither melt nor flake under atmospheric conditions between temperatures of 40 deg. F. below zero and 185 deg. F. above zero.

28. *Inspection.*

(a) Purchaser may inspect the completed product to determine that the requirements of this specification have been met.

(b) If product has not been accepted at point of production and if, upon arrival at destination, it does not meet the requirements of this specification, it may be rejected, and the Manufacturer, upon request, shall advise the Purchaser what disposition is to be made of the rejected product. Manufacturer shall pay all shipping charges.

(c) If Purchaser is to make inspection at point of production it shall be so stated on Purchaser's order.

29. *Packing.*

(a) Product shall be so assembled or packed as to permit convenient handling and to protect against loss or damage during shipment.

30. *Marking.*

(a) Purchaser's order, requisition and package number, name of Consignor, and name and address of Consignee, shall be plainly marked on outside of package.

31. *Warranty.*

(a) Manufacturer shall warrant the product covered by this specification to be free from defects in material and workmanship under ordinary use and service, his obligation under this warranty being limited to manufacturing, at point of production, any part or parts to replace those which shall be found defective within 1 year after shipment to the Purchaser. This warranty shall not apply to any product which shall have been repaired or altered in any way by anyone other than the Manufacturer thereof, so as to affect, in the Manufacturer's judgment, its proper functioning or reliability or which has been subjected to misuse, negligence or accident.

Alternate requisites.

R-7-a.

Ranges shall be as follows:

Voltage ranges	Ampere ranges
1.5	0.03
3	0.15
15	0.3
30	1.5
150	3
300	15
	30

1. Voltmeter shall be made with ranges, not exceeding six, as specified by the Purchaser.

2. Ammeter shall be made with ranges, not exceeding six, as specified by the Purchaser.

3. Volt-ammeter shall be made with voltage ranges and ampere ranges, not exceeding six, as specified by the Purchaser. (Combinations for volt-ammeters are usually made up of three of the voltage ranges in combination with three of the ampere ranges.)

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Specification 85-46—Portable Direct Current Voltmeters, Ammeters and Volt-Ammeters, Manual Part 168.

(Revision of A.A.R. Signal Section Specification 115-46)
A.A.R. SIGNAL SECTION SPECIFICATION 115-52.

PORTABLE ALTERNATING CURRENT VOLTMETER

1. Purpose.

(a) This specification is for the purpose of providing for a portable alternating current voltmeter.

2. Tender.

(a) The tender shall be for a product meeting the requirements of this specification in its entirety.

3. Purchaser's order requirements.

(a) The following additional requirements will be shown on Purchaser's order:

1. Class of instrument as specified in section 5-b.
2. Range of instrument as specified in section 6-a.
3. Fuses and selector switch when required.
4. Carrying case when required.
5. Inspection and tests as required.

4. Material and workmanship.

(a) Material and workmanship shall be first-class in every respect.

5. Design.

(a) Instrument shall be self-contained of a design acceptable to the Purchaser.

(b) Instruments shall be of two general classes:

1. Those having a 4 in. minimum scale length for use when a relatively high degree of accuracy is desired.
2. Those having a $2\frac{1}{2}$ in. minimum scale length for use when a less accurate reading is acceptable.

6. Ranges and scales.

(a) Ranges and scales shall be as follows:

Item No.	Volts	Minimum length of upper arc, in.	Divisions*	No. of blocks*	Divisions per block*
1	0-75	4	150	15	10
	0-150				
	0-300				

* Scale divisions and blocks to conform to values specified as far as practicable.

6. *Ranges and scales.*—Continued.

Item No.	Volts	Minimum length of upper arc, in.	Divisions*	No. of blocks*	Divisions per block*
2	0-75 0-150 0-300	2½	75	7½	10
3	0-1 0-5 0-25 0-125	4	100 125	10 12½	10 10
4	0-1 0-5 0-25 0-125	2½	50	5	10

* Scale divisions and blocks to conform to values specified as far as practicable.

(b) The figures used for the numbering of scales shall be legible and as large as practicable.

(c) Scales shall not be affected by moisture or changes in temperature.

7. *Binding posts.*

(a) Connections to instrument shall be made on binding posts.

(b) Binding posts shall be mounted so they cannot be turned in the base or frame to which applied. They shall be properly insulated from each other and other metallic parts.

(c) Binding posts need not be marked in single range or multiple range instruments employing a selector switch, but the common post on the multiple range instruments with separate binding posts for each range shall be marked with plus and minus ($\pm$) mark. The other posts on multiple range instruments shall be marked to correspond with the respective ranges.

(d) Binding post nuts shall be so designed that they will not come off in normal use.

(e) Binding posts shall be insulated.

8. *Range selecting switch.*

(a) Where a range selecting switch is used, the switch positions shall be plainly and permanently marked to indicate the range in use.

9. *Fuses.*

(a) Where fuses are provided:

1. They shall be clearly and permanently marked for the purpose intended.

2. They shall be accurately calibrated so that they will not appreciably affect the accuracy of the ranges in which they are to be used.

10. *Zero corrector.*

(a) An external zero corrector shall be provided on each instrument.

11. *Pointer.*

(a) Pointer shall be the knife-edge type.

12. *Mirror.*

(a) Scale of instruments shall be provided with mirror directly under knife-edge of the pointer.

13. *Moving element.*

(a) The moving element shall turn on hardened accurately ground and highly polished steel or equivalent pivots, bearing on highly polished first-quality sapphires or equivalent jewels. The moving element shall respond quickly to changes in current and shall have a damping factor of not less than three.

14. *Heating.*

(a) Instruments shall not over-heat or show an appreciable error, when left in the circuit indefinitely at full load.

15. *Case.*

(a) Instrument case shall be constructed with close fitting joints to minimize the entrance of dust and moisture and shall have a neat and durable finish.

16. *Sealing.*

(a) Instrument shall be sealed to prevent any changes or adjustments except by means of the zero corrector.

17. *Current loss.*

(a) Current losses for various combinations, section 6-a, shall be as follows:

1. Not less than 15 ohms per volt, for Item No. 1.
2. Not less than 30 ohms per volt, for Item No. 2.
3. Not less than 100 ohms per volt, for Item No. 3.
4. Not less than 20 ohms per volt, for Item No. 4.

18. *Accuracy.*

(a) Instruments having a 4 in. minimum scale shall be accurate within plus or minus 0.75 per cent of full scale deflection at 77 deg. F. at 60 cycles a.c.

(b) Instruments having a $2\frac{1}{2}$ in. minimum scale shall be accurate within plus or minus 1 per cent of full scale deflection at 77 deg. F. at 60 cycles a.c.

(c) This accuracy shall apply only throughout the upper two-thirds of the scale length.

19. *Errors due to temperature and frequency.*

(a) Temperature error.

1. Instruments having a 4 in. minimum scale shall not have a temperature error exceeding 0.3 per cent of the indicated value for a change of plus or minus 10 deg. F. Instruments shall be adjusted for 77 deg. F. at 60 cycles a.c.

2. Instruments having a $2\frac{1}{2}$ in. minimum scale shall not have a temperature error exceeding 0.8 per cent of the indicated value for a change of plus or minus 10 deg. F. Instruments shall be adjusted for 77 deg. F. at 60 cycles a.c.

(b) Frequency error.

1. Instruments having a 4 in. minimum scale shall not have a frequency error exceeding 0.75 per cent of the indicated value when used over a range from 25 to 100 cycles. Instruments shall be adjusted for use on 60 cycles a.c.

2. Instruments having a $2\frac{1}{2}$ in. minimum scale shall not have a frequency error exceeding 0.75 per cent of the indicated value for instruments per Item No. 2, section 6-a, and not exceeding 3 per cent of the indicated value for instruments per Item No. 4, section 6-a, when used over a range from 25 to 100 cycles. Instruments shall be adjusted for use on 60 cycles a.c.

20. *Data for reference.*

(a) Instruments shall have the resistance of ranges plainly and permanently marked either on the face of the instrument or on a certificate or marking plate permanently attached to the instrument.

21. *Name plate.*

(a) Name plate showing Manufacturer's name, model and serial numbers shall be attached to each instrument unless this information is shown on dial.

22. *Dielectric requirements.*

(a) The instrument assembled shall withstand for 1 minute an insulation test, at place of manufacture, of 2,600 volts a.c. between all parts of electric circuits and other metallic parts insulated therefrom.

23. *Finish.*

(a) Metal parts shall be protected against corrosion except where such protection will interfere with the proper functioning of that part.

(b) Material used for protection against corrosion shall neither melt nor flake under atmospheric conditions between temperatures of 40 deg. F. below zero and 185 deg. F. above zero.

24. Inspection.

(a) Purchaser may inspect the completed product to determine that the requirements of this specification have been met.

(b) If product has not been accepted at point of production and if, upon arrival at destination, it does not meet the requirements of this specification, it may be rejected, and the Manufacturer, upon request, shall advise the Purchaser what disposition is to be made of the rejected product. Manufacturer shall pay all shipping charges.

(c) If Purchaser is to make inspection at point of production it shall be so stated on Purchaser's order.

25. Packing.

(a) Product shall be so assembled or packed as to permit convenient handling and to protect against loss or damage during shipment.

26. Marking.

(a) Purchaser's order, requisition and package number, name of Consignor, and name and address of Consignee, shall be plainly marked on outside of package.

27. Warranty.

(a) Manufacturer shall warrant the product covered by this specification to be free from defects in material and workmanship under ordinary use and service, his obligation under this warranty being limited to manufacturing, at point of production, any part or parts to replace those which shall be found defective within 1 year after shipment to the Purchaser. This warranty shall not apply to any product which shall have been repaired or altered in any way by anyone other than the Manufacturer thereof, so as to affect, in the Manufacturer's judgment, its proper functioning or reliability, or which has been subjected to misuse, negligence or accident.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Specification 115-46—Portable Alternating Current Voltmeter,
Manual Part 169.

A.A.R. SIGNAL SECTION INSTRUCTIONS.

ELECTRIC SWITCH LOCKS*

1952

These instructions apply to the installation, maintenance and test of electric locks applied to hand-operated switches. They set forth general requirements representing recommended practice.

1. Maintenance, tests and repair work which may interfere with safe operation of trains must not be started until train movements have been fully protected. Temporary repairs or adjustments, when required, must be made in such manner that safety of train operation will not be impaired. When repair, adjustment, change or replacement is made, tests must be made immediately to determine that the apparatus functions as intended. When making tests of apparatus, proper instruments must be used and it must be known that no unsafe conditions are set up by the application of testing equipment.
2. When electric lock is to be changed, temporarily removed, or becomes defective, proper measures must be taken as instructed to protect train movements, until electric lock is restored to normal operation.
3. Electric locks must be installed and maintained as instructed so as to conform to established clearances for equipment.
4. Electric locks must be securely fastened in place.
5. Magnetic air gap must not be changed in the field.
6. Contacts must be kept clean and in proper adjustment as instructed. Contact openings must be not less than 0.050 inch when open.
7. Movable parts must be kept clean, properly adjusted and lubricated as instructed.
8. Parts which fail to perform their intended functions must be promptly adjusted, repaired or replaced.
9. Bolts, nuts, pins and cotters of proper size and type must be kept in place, nuts kept tight and cotters properly spread.
10. Covers and fastenings must be kept in good condition with suitable gaskets in place.
11. All padlocks or seals must be maintained as instructed.
12. Ventilator screens must be in place and kept free of paint or other obstruction.
13. Wire and cable entrances must be properly sealed to prevent entrance of moisture, rodents and insects.
14. Threads of rods, jaws and bolts must be kept clean and properly lubricated.
15. Paint must be applied as often as required. Rusty surfaces must be cleaned before painting. Paint must not be applied to padlocks, threads of screw jaws, adjusting screws, or gaskets.

* The term "as instructed" as used herein refers to individual railroad instructions.

16. Edges of locking dogs or notches must be examined frequently and any having rounded or otherwise distorted locking surfaces must be replaced.

17. Locking plungers or dogs must not be lubricated.

18. Tests must be made as instructed to determine that:

(a) Signals governing movements over switch are displaying proper restrictive indications, when electric lock is unlocked or when switch is not in proper position.

(b) Movement of train over switch will not cause contacts to open or close improperly.

(c) Operation of emergency means for unlocking, where provided, will cause signals to display the proper restrictive indications.

(d) Any preliminary movement of the electric lock mechanism, before securing an electrical unlock, must not be enough to permit switch operation.

(e) Electric lock unlocks to permit train or engine to enter main track by either of the following:

1. Without a time interval when approach control track circuits are unoccupied.

2. After signal control circuits have been opened and after the expiration of a time interval, determined in accordance with Instructions for Time Releases Applied to Signal Apparatus, Manual Part 128.

(f) Electric lock unlocks to permit train or engine to leave main track by either of the following:

1. Without a time interval by de-energization of track relay for short track circuit where used.

2. After expiration of a predetermined time interval when initiated manually at the switch or initiated by de-energization of track relay for track circuit or circuits immediately in advance of the switch.

19. Pick-up and drop-away tests must be made periodically as instructed.

20. Electric locks removed from service for repairs must be returned with full information as required on repair tag Form 7018, Manual Part 124, as instructed.

21. Results of inspection and tests herein required and all other inspections and tests that may be required must be recorded as instructed.

Action Recommended

Acceptance for submission to letter ballot.

**SIMPLIFIED SYSTEM OF NUMBERING AND IDENTIFICATION
OF WIRES AND CIRCUITS WHICH DOES NOT REQUIRE THE
CHANGING OF NOMENCLATURE AND TAGS ON WAYSIDE
CIRCUITS WHEN A MINOR CHANGE IS MADE**

In connection with this assignment, a questionnaire, Inquiry SS-91A, was issued to Voting Representatives of Member Roads in the Signal Section. Seventy-six replies were received, indicating that a majority are using the system outlined in Manual Part 33, which requires the changing of nomenclature and tags on wayside circuits when a minor change is made. They do, however, in many instances, make minor modifications to the system outlined in Manual Part 33, principally to accommodate the system to local conditions and individual railroad practice. Some of these modifications are:

1. Break numbers $1/4-1/2-3/4$.
2. By use of decimal numbers.
3. By use of alphabetical suffix.
4. By eliminating break numbers.

The majority indicated that they know of no simplified system which will avoid the changing of the nomenclature and tags throughout the wayside circuit when a minor change is made.

Action Recommended

Acceptance as information.

(Revision and Consolidation of Instructions for Non-Coded Direct Current Track Circuits, Instructions for Non-Coded Alternating Current Track Circuits, and Instructions for Coded Direct Current Track Circuits)
A.A.R. SIGNAL SECTION INSTRUCTIONS.

TRACK CIRCUITS*

1952

These instructions apply to the installation, maintenance and test of track circuits. They set forth general requirements representing recommended practice.

General.

1. Maintenance, tests and repair work which may interfere with safe operation of trains must not be started until train movements have been fully protected. Temporary repairs or adjustments, when required, must be made in such manner that safety of train operation will not be impaired. When repair, adjustment, change or replacement is made, tests must be made immediately to determine that the apparatus functions as intended. When making tests of apparatus, proper instruments must be used and it must be known that no unsafe conditions are set up by the application of testing equipment.

2. The length of any track circuit, except trap circuit or special circuit not used for control of signaling facilities, must be maintained greater than maximum inner wheel base of any engine or car.

3. Where shortest outer wheel base of an engine or car operating over any dead section is less than 35 feet, the maximum length of the dead section must be so maintained that it will not exceed the length of the outer wheel base of such engine or car unless special circuit is used.

4. Bonding must be installed and maintained in condition to insure low resistance. Bolts in angle bars should be kept tight.

5. Bonding must be inspected as instructed and renewed as required.

6. Each wire must be tagged or otherwise marked so it can be identified at each terminal. Nomenclature must correspond to that of the circuit plan. Tags or other marks of identification in instrument cases and apparatus housings must be made of insulating material. Wires, tags, or other markings must not interfere with moving parts of apparatus.

7. Parts which fail to perform their intended functions must be promptly adjusted, repaired or replaced.

8. When track or other conditions are such that they may cause signal interruption or unsatisfactory operation of signal apparatus, the section foreman, or whoever is immediately responsible for such conditions, must be requested to remedy the condition. If such request is not acted upon within a reasonable time, the matter must be reported to proper authority in writing.

* The term "as instructed" as used herein refers to individual railroad instructions.

General.—Continued.

9. Shunt wires and fouling wires, except shunt wires to switch circuit controller through which signal control circuits are controlled and track circuits are shunted, must consist of at least two conductors and each must be of sufficient conductivity and maintained in such condition that the track relay will be in de-energized position when the circuit is shunted.

10. Fouling section of turnout must be so maintained that it will extend to clearance point or as instructed.

11. Track relay must be in de-energized position whenever any of the following conditions exist, and the track circuit of an automatic train stop, train control, or cab signal system must be de-energized in the rear of the point where any of the following conditions exist:

(a) When a rail is broken or a rail or switch frog is removed except when a rail is broken or removed in the shunt fouling circuit of a turnout or crossover, provided, however, that shunt fouling circuit may not be used in a turnout through which permissible speed is greater than 45 miles per hour.

(b) When a train, engine, or car occupies any part of a track circuit, including fouling section of turnout, except turnouts of a hand-operated main track crossover.

(c) Where switch shunting circuit is used:

1. Switch point is not closed in normal position.

2. A switch is not locked where facing point lock with circuit controller is used.

3. An independently operated fouling point derail equipped with switch circuit controller is not in derailing position.

12. Where practicable, top of rails should be kept free from sand, rust, dirt, or other foreign matter that prevents effective shunting of track circuit.

13. Track circuit connectors and connections must be maintained in good condition.

14. Pipe lines under rail must clear base of rail at least $\frac{1}{2}$ inch.

15. Lightning arresters and made grounds must be properly connected, maintained and tested as instructed.

16. Ballast resistance should be kept as high as possible by keeping ballast free from rail and rail fastenings and providing proper drainage. Broken track spikes must not be driven through ties.

17. Resistance of ballast should preferably be not less than 2 ohms per 1,000 feet of track.

18. When making train shunt resistance test it should be made in accordance with Form 7003, Manual Part 196.

19. Shunting sensitivity test of a track circuit must be made by determining the maximum resistance that can be placed across the rails opposite the relay and opposite the source of energy to cause the relay to assume its de-energized position.

(a) Where track circuits include turnouts or crossovers, additional shunting sensitivity tests must be made at the following locations:

1. Turnouts.

(a) Switch point side of insulated joints in lead rails and at each end of fouling circuit.

General.—Continued.

2. Crossovers.

(a) Switch point side of insulated joints in lead rails and both sides of insulated joints at center of crossover.

(b) Where center insulated joints are not used, make tests at locations specified in Instruction 19-a-1.

(b) If the shunt resistance is less than 0.06 ohm, corrective measures must be taken at once.

20. Shunting tests must be made during dry weather conditions when the maximum current is flowing through the relay coils.

21. Switch circuit controllers must be maintained and tested in accordance with Instructions for Switch Circuit Controllers, Manual Part 134.

22. Insulated rail joints must be maintained and tested in accordance with Instructions for Insulated Rail Joints, Manual Part 133.

23. Wire and cable must be maintained and handled in accordance with Instructions for Wire and Cable, Manual Part 190.

24. Ground resistance must be maintained and tests made in accordance with Instructions for Made Grounds, Manual Part 61.

25. Unauthorized experiments or alterations in track circuits must not be made.

26. Any unusual occurrences or developments in track circuits must be promptly reported to proper authority.

27. Results of inspections and tests herein required and all other inspections and tests that may be required must be recorded as instructed.

Non-coded direct current track circuits.

28. Track circuits must be so adjusted that proper working current will flow through the coils of relay during minimum ballast resistance conditions, and checks made to determine that under these conditions, or under maximum ballast resistance conditions, the current through the coils of track relay will not exceed 30 milliamperes for 2-ohm relays or 20 milliamperes for 4-ohm relays, having iron magnetic structure, and will not exceed 40 milliamperes for 2-ohm relays or 27 milliamperes for 4-ohm relays, having silicon steel magnetic structure, with train shunt applied as specified in Tables I, II, III and IV of Formulae for Computing Minimum Allowable Resistance between Track Battery and Track and for Computing Related Current and Voltage Data, Manual Part 132.

29. Where relayed cut-section is used in territory where non-coded direct current track circuits are in use, the energy circuit to the adjoining track circuit must be open and the track circuit shunted when the track relay at such cut-section is in de-energized position.

30. At grade crossing with an electric railroad where foreign current is present, the electric energy for non-coded direct current track circuit must feed away from the crossing. To minimize the effect of foreign current on direct current track circuits, follow Manual Part 127.

31. For track circuits having 2-ohm or 4-ohm relays, resistance between battery and rails must be not less than that shown in Tables I, II, III and IV of Formulae for Computing Minimum Allowable Resistance between Track

Non-coded direct current track circuits.—Continued.

Battery and Track and for Computing Related Current and Voltage Data, Manual Part 132.

32. For track circuits having relays other than 2-ohm or 4-ohm resistance, minimum limiting resistance allowable in series with track battery must be maintained as instructed.

33. Direct current track circuit tests must be made in accordance with Forms 7021 and 7022, Manual Part 131.

34. Relays must be maintained and tested in accordance with Instructions for Direct Current Relays, Manual Part 126.

35. Cells and batteries must be maintained and tested in accordance with Instructions for Cells and Batteries, Manual Parts 7 and 14.

36. Rectifiers and motor-generators must be maintained and tested in accordance with Instructions for Rectifiers and Motor-Generators, Manual Part 68.

Coded direct current track circuits.

37. Track circuits must be so adjusted that proper working current will flow through the coils of relay during minimum ballast resistance conditions.

38. With an 0.06 ohm train shunt applied at the battery end of the track circuit, tests must be made during maximum ballast resistance conditions, as well as during minimum ballast resistance conditions to determine that the current through the coils of relay is less than the minimum pick-up value or field requirement as established by the instructions for the particular relay installed. These tests must be made under conditions of maximum voltage characteristic for the type of battery in service.

39. Direct current track circuit tests must be made in accordance with Forms 7021 and 7022, Manual Part 131.

40. Relays must be maintained and tested in accordance with Instructions for Direct Current Relays, Manual Part 126.

41. Cells and batteries must be maintained and tested in accordance with Instructions for Cells and Batteries, Manual Parts 7 and 14.

42. Rectifiers and motor-generators must be maintained and tested in accordance with Instructions for Rectifiers and Motor-Generators, Manual Part 68.

43. Resistance between battery and rails must be not less than that established as the minimum for each type of relay installed as instructed.

Non-coded alternating current track circuits.

44. The adjustment of alternating current track circuits depends on many factors, such as the type of track circuit; whether double or single rail with steam or electric traction; the length of the track circuit; the ballast condition; the desired shunting values at both relay and transformer ends of the track circuit; the type of relay; and the weight of train equipment.

45. Voltage at the relay local terminals must be as near as possible the normal voltage given on the manufacturer's tag or name plate. If less than the normal voltage value is impressed across the local terminals, more energy will have to be used in the track element to cause proper operation, except for centrifugal frequency relays. While a reduction in the local voltage of a

Non-coded alternating current track circuits.—Continued.

centrifugal frequency relay generally does not require additional energy to the track element, this reduction in the local voltage should be avoided as it tends to increase the time of shunting.

46. For single-element relays, the voltage at the relay track terminals under wet ballast or other adverse conditions must be at least 10 per cent higher than the values given on the manufacturer's tag or name plate to take care of varying ballast conditions and bonding. For two-element relays, the voltage on the relay track terminals under wet ballast or other adverse conditions must be 10 per cent higher than that necessary to energize the relay with normal front contact compression. On account of varying phase angle conditions the necessary voltage on the track element may be considerably in excess of the values marked on the manufacturer's tag or name plate. A check for the proper voltage to be applied across the track terminals of a relay under wet or other unfavorable conditions, is to shunt the relay so that its contacts open halfway, then remove the shunt, and if the contacts come up to the front stop, sufficient energy is passing through the track windings.

47. When shunting two-element track relays, shunt must be applied at the terminals of the track element and not the local element.

48. On steam road track circuits the voltage on the rails at transformer end should be not more than one-half that at the transformer secondary under the worst track conditions. Where reactive transformers are in use, the voltage on the rails at transformer end should be not more than one-half the open circuit transformer secondary voltage.

49. To obtain adequate broken-rail protection on electric road track circuits, it may be necessary to make adjustments so that under worst track conditions the voltage at the rails opposite the transformer is two-thirds that of the transformer secondary. Where reactive transformers are in use the voltage on the rails at transformer end should be not more than two-thirds the open circuit transformer secondary voltage.

50. To obtain the best operation of two-element track relays under adverse ballast conditions, phase measuring instruments should be used to determine that the phase angle relations in the relay approach the ideal value. These measurements may indicate that adjustments should be made to improve phase relations.

51. Alternating current track circuit tests must be made in accordance with A.C. Track Circuit Characteristics, Manual Part 161.

52. Relays must be maintained and tested in accordance with Instructions for Alternating Current Relays, Manual Part 124.

53. Where two-element track relays are used, polarities of adjacent track circuits must be staggered when the signals are in the clear position.

54. To obtain broken-rail detection on electric road track circuit, it is desirable that cross-bonds between neutral connections of impedance bonds on parallel tracks or between a neutral connection and a negative propulsion return cable should not be located closer than at alternate impedance bond locations. Calculations should be made and checked by field tests under the most adverse conditions so that the cross-bonding as installed does not interfere with the desired broken-rail detection.

55. Both rails of a double-rail electric road track circuit should be equally well bonded because defective bonding in one rail will cause an unbalanced

Non-coded alternating current track circuits.—Continued.

condition of the track circuit due to unequal amounts of return propulsion current in the two rails.

(a) With direct current propulsion and double-rail track circuits, unbalanced propulsion current may saturate the iron core of the impedance bonds. This may lower the bond impedance to such a point that the track relay may be shunted.

(b) With alternating current propulsion and double-rail track circuits, unbalanced propulsion current will cause the impedance bond to act as an auto-transformer. Since the track relay is connected in multiple with the bond the auto-transformer voltage may cause sufficient alternating current of propulsion frequency to flow in the relay to cause it to open its contacts, or to blow the protective fuse.

56. Where single-rail track circuits are used on electric roads, care must be taken to adjust the resistors at the relay and transformer ends so that the amount of propulsion current permitted to flow through the relay track winding is less than the allowable amount specified for a given relay. Where heavy direct current propulsion is present, a shielding or a balancing impedance may also be installed in connection with the track relay to protect against direct current in the relay windings.

57. The current limiting device used in the transformer track lead should be a reactor if possible, as the losses in a reactor are less than in a resistor. A resistor in place of a reactor should be used only when required to give correct phase relations in two-element track relays or to protect the relay and transformer from propulsion return current.

58. Fuses must be inspected as instructed and replaced in kind when necessary.

59. To measure the current the relay is receiving from the track circuit, measure first the voltage across the relay track terminals, then insert an ammeter in the track leads and again measure the terminal voltage. This voltage divided by the current gives the impedance of the relay which corresponds to the resistance of a direct current relay. Divide the relay terminal voltage, read with the ammeter removed, by the impedance. The result obtained will be the relay current.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Instructions for Non-Coded Direct Current Track Circuits, Manual Part 8.
Instructions for Non-Coded Alternating Current Track Circuits,
Manual Part 162.
Instructions for Coded Direct Current Track Circuits, Manual Part 218.

(Revision of Instructions for Copper-Oxide Caustic Soda Primary Cells)
A.A.R. SIGNAL SECTION INSTRUCTIONS.

COPPER-OXIDE CAUSTIC SODA PRIMARY CELLS*

1952

These instructions apply to the installation, maintenance and test of copper-oxide caustic soda primary cells. They set forth general requirements representing recommended practice.

1. Maintenance, tests and repair work which may interfere with safe operation of trains must not be started until train movements have been fully protected. Temporary repairs or adjustments, when required, must be made in such manner that safety of train operation will not be impaired. When repair, adjustment, change or replacement is made, tests must be made immediately to determine that the apparatus functions as intended. When making tests of apparatus, proper instruments must be used and it must be known that no unsafe conditions are set up by the application of testing equipment.

2. Parts which fail to perform their intended functions must be promptly adjusted, repaired or replaced.

3. Instructions issued by manufacturers must be followed unless they conflict with general or detailed instructions in which case proper authority must be consulted.

4. Cells must be protected against rain, snow, extreme heat or cold, and should be kept clean.

5. Where freezing temperatures prevail, outside housings should be installed and maintained as instructed.

6. Housings should be located so as to prevent flooding.

7. Cells must set level on floors, shelves or racks. Where required, provision must be made to keep cells from shifting.

8. The performance should be recorded on Form 7007 as instructed.

9. Material for one complete cell (except water) must consist of the following:

- 1 Jar
- 1 Cover
- 1 Hexagonal nut
- 2 Wing nuts
- 2 Washers
- 1 Complete renewal

10. Material for one complete renewal must consist of the following:

- 1 Element
- 1 Can caustic soda
- 1 Bottle battery oil

11. Renewals must not be unpacked except as required.

* The term "as instructed" as used herein refers to individual railroad instructions.

12. Elements must not be lifted or carried by their connecting wires.
13. Packages containing cells or renewals must be kept dry.
14. Caustic soda which has been damaged by exposure to air or dampness must not be used.
15. Care must be exercised in handling the dry soda or mixed solution because caustic soda is a caustic poison which will burn or injure the skin, eyes or clothing. It must never be taken internally. Where the skin is likely to be burned from exposure to caustic soda, it is good practice to protect to some extent the exposed skin by applying a coating of vegetable or animal oil, such as olive, linseed, cottonseed, castor or lard. If these oils are not available, mineral oil is of some value, although not as effective as the oils mentioned. If caustic soda does come in contact with the skin, it should immediately be washed off with plenty of water and neutralized with a weak acid such as vinegar. If a skin burn has resulted from contact with the caustic soda, after washing with water, apply one of the vegetable or animal oils specified herein. Mineral or lubricating oil may also be used but it is not as effective. Should caustic soda get into the eye, immediately wash with plenty of water, flush freely with a pure vegetable oil, such as olive oil, and get to a physician as soon as possible. Where caustic soda has been taken internally, immediately drink vinegar and water in equal parts or lemon juice and water in equal parts, and get to a physician as soon as possible. If clothing becomes wet with caustic soda solution, it should immediately be removed. If the wet portion of the clothing came in contact with the skin, the skin should be treated as recommended herein. Such clothing should be thoroughly washed before it is worn again. The above treatment of caustic burns is that recommended by the manufacturers of caustic soda primary batteries as good first-aid practice until medical assistance can be obtained.

Setting up and renewing cells.

16. Material must be checked to see that jars, covers, nuts, washers, elements, caustic soda and oil are of proper size and quantity.
17. Separators and other packing material must be removed from elements.
18. Elements must be examined to see that they hang approximately in a vertical position, that the electrodes are parallel to each other and uniformly spaced, and that connections are firmly made. Broken or cracked electrodes must not be used.
19. Jars and covers must be thoroughly cleaned. Cracked or defective jars or covers must not be used.
20. Material unfit for use must be called to attention of proper authority for disposition.
21. Clean water must be used for mixing solution. Water containing an excess of metallic salt, acid, alkali, sewage or other impurities must not be used.
22. Jars should be filled with clean water to within approximately $2\frac{3}{4}$ inches from the top or as specified in manufacturer's instructions.
23. Caustic soda must be added gradually and stirred with a circular and pendulum-like movement until thoroughly dissolved, using a clean, untreated strip of wood which should be long enough to reach the bottom of the jar.
24. The exact amount of soda and only that furnished by the manufacturer for the type of renewal must be used.

Setting up and renewing cells.—Continued.

25. Connecting wire and suspension bolt must be passed through holes in cover and element securely tightened to cover by means of hexagonal nut. Two washers and two wing nuts must be placed above the hexagonal nut. Before applying element to cover, bend connecting wire so that it will pass freely through hole in cover to prevent damage to insulation. Avoid bending wire at point where it is connected to electrode.

26. If the cells being set up or renewed are for normally open circuit service or for service where the discharge rate is very low, any special instructions issued by the manufacturer for such service must be followed.

27. Element must be inserted in solution, where practicable, after jars have been placed in permanent position. Where necessary, water must be added to bring top of solution, when cool, $\frac{3}{4}$ inch from top of jar with electrodes in position and stirred thoroughly by agitating entire bulk of solution by a pendulum movement of narrow stick reaching to bottom of jar. Solution must never touch underside of cover but must be well above top of electrodes.

28. Oil of the exact amount and kind furnished by manufacturer of renewal must be added to top of solution after element is permanently in place. Element should not be raised through the oil.

29. Connections must be clean and tight.

30. Except when necessary to make replacements of individual cells, all cells of a battery should be renewed at the same time.

31. Discarded solution, cans and bottles must be disposed of where they will not damage property, inflict injury to persons, animals, etc., nor pollute any stream or source of water supply. Cans should be flattened out when emptied.

32. Exhausted elements must be drained and then spaced on racks, floors, or shelves away from inflammable material until thoroughly dry, after which they must be placed in paper bags, if available, then packed and forwarded to the storehouse or other designated place. Each container to contain only one type and make and plainly marked to show name of shipper, quantity, type and manufacture.

33. Exhausted elements, after being packed, must be kept dry as chemical action, when wet, may cause fire. Containers should be labeled "Keep Dry."

Inspection.

34. Battery must be inspected, tested and renewed as often as necessary. Voltage readings of the battery should be taken during maximum discharge.

35. Any unusual appearance or performance of cells must be promptly reported to proper authority. If cells must be replaced, the old cells, where practicable, should be held intact for instructions as to disposition.

Adjustment of rectifiers used with Type A primary cells.

36. Rectifiers must be adjusted when each cell reads 0.85 volt. New cells reading over 0.85 volt should be brought down to this voltage by temporarily discharging them through a resistance while making the adjustment. Cells which read less than this voltage should be brought up to 0.85 volt by charging the cells for a short period before permanently adjusting rectifiers.

37. When adjusting rectifiers, make sure that the primary cells do not receive more charge than discharge, calculated in ampere hours, over a definite

Adjustment of rectifiers used with Type A primary cells.—Continued.

period of time such as 24 hours. The output of the rectifier should always be slightly less than the entire current requirement of the circuit.

38. If the rectifier is set too high and the cells are being charged, this condition will be indicated by an increase in the thickness of the extreme lower portion of the zinc electrode, or by the formation of a "mossy" deposit on the surface of the electrodes. These warnings will appear depending on the state of exhaustion of the cells as well as upon the rate and duration of the charge long before any permanent damage can be done to the battery.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Instructions for Copper-Oxide Caustic Soda Primary Cells, Manual Part 7.

(Revision of Instructions for Car Retarder Systems)
A.A.R. SIGNAL SECTION INSTRUCTIONS.

CAR RETARDER SYSTEMS*

1952

These instructions apply to the installation, maintenance and test of car retarder systems. They set forth general requirements representing recommended practice.

1. Maintenance, tests and repair work which may interfere with safe operation of cars must not be started until movements have been fully protected. Temporary repairs or adjustments, when required, must be made in such manner that safety of operation will not be impaired. When repair, adjustment, change or replacement is made, tests must be made immediately to determine that the apparatus functions as intended. When making tests of apparatus, proper instruments must be used and it must be known that no unsafe conditions are set up by the application of testing equipment.

2. Each circuit, the functioning of which affects the safety of operation, must be kept free of any ground or combination of grounds as instructed. In no case shall a flow of current be permitted which is equal to or in excess of 75 per cent of the release value of any relay or other electromagnetic device in the circuit.

3. Each wire must be tagged or otherwise marked so it can be identified at each terminal. Nomenclature must correspond to that of the circuit plan. Tags or other marks of identification in instrument cases and apparatus housings must be made of insulating material. Wires, tags, or other markings must not interfere with moving parts of apparatus.

4. Control machine must be kept in good condition, free from dust, grease, dirt and excessive lost motion. Contacts must be kept clean and in proper adjustment.

5. During snow and sleet storms, switches and skates must be kept clear of snow and ice. Where open flame snow melting apparatus is used, care must be exercised to prevent damage to apparatus.

6. Doors, covers and fastenings must be kept in good condition, with suitable gaskets in place.

7. All locks or seals must be maintained as instructed.

8. Apparatus must be maintained as instructed so as to conform to established clearances.

9. Paint must be applied as often as required. Rusty surfaces must be cleaned before painting. Paint must not be applied to threads of screw jaws, adjustable screws, cotters or gaskets. Paint or oil must not be applied to friction surfaces of retarder shoes or skates.

* The term "as instructed" as used herein refers to individual railroad instructions.

10. Movable parts must be kept clean and free from foreign material, properly adjusted and lubricated as instructed.

11. Bolts, nuts, dowel pins, pins and cotters of proper size and type must be kept in place, nuts and dowel pins kept tight and cotters properly spread.

12. Parts which fail to perform their intended functions must be promptly adjusted, repaired or replaced.

13. Lightning arresters and made grounds must be properly connected, maintained and tested as instructed.

14. Threads of rods, jaws and bolts must be kept clean and properly lubricated.

15. Retarders, switch and skate operating mechanisms must be kept in good condition and free from excessive lost motion. Manufacturer's instructions as to adjustments and maintenance must be followed unless they conflict with other general or detailed instructions, in which case proper authority must be consulted. All bearing parts must be kept properly lubricated. Lubricants used should be suitable to the weather encountered and should be in accordance with the recommendation of the manufacturer. Contacts must be kept clean and properly adjusted.

16. Grease and dirt should be cleaned off the top of retarder beams and shoes and from beneath the shoes and the rails, and from underneath the operating parts.

17. Height of retarder shoes above the rail and distance between retarder shoes with retarder in open position must be maintained as instructed.

18. Retarder shoes must be replaced when worn out and care must be used when installing new or partially worn shoes to insure that one does not project beyond an adjacent shoe far enough for a wheel to hit and be lifted. Broken shoes which leave such a projection must be changed immediately.

19. When retarder shoes or beams are removed from one section of a retarder while the remainder of the machine is kept in service, tapered end shoes must be used or equivalent protection provided, as instructed, at both ends of the operable section so that a car wheel will enter the shoes without lifting.

20. Power-operated skate mechanism must be tested after each skate replacement to make certain it is functioning as intended.

21. Skates must be inspected periodically to insure that points are not bent or broken and that friction surfaces are in good condition.

22. Cells and batteries must be maintained and tested in accordance with Instructions for Cells and Batteries, Manual Parts 7 and 14.

23. Electric lamps must be maintained and tested in accordance with Instructions for Incandescent Electric Lamps, Manual Part 120.

24. Insulated rail joints must be maintained and tested in accordance with Instructions for Insulated Rail Joints, Manual Part 133.

25. Rectifiers and motor-generators must be maintained and tested in accordance with Instructions for Rectifiers and Motor-Generators, Manual Part 68.

26. Relays must be maintained and tested in accordance with Instructions for Relays, Manual Parts 124 and 126.

27. Signals must be maintained and tested in accordance with Instructions for Light and Semaphore Signals, Manual Part 54.

28. Switch circuit controllers must be maintained and tested in accordance with Instructions for Switch Circuit Controllers, Manual Part 134.

29. Track circuits must be maintained and tested in accordance with Instructions for Track Circuits, Manual Part 8.

30. Wire and cable must be maintained and handled in accordance with Instructions for Wire and Cable, Manual Part 190.

31. Insulation resistance tests must be made in accordance with Instructions for Insulation Resistance, Manual Part 130.

32. Ground resistance test must be made in accordance with Instructions for Made Grounds, Manual Part 61.

33. Electro-pneumatic car retarders must be maintained in accordance with Instructions for Interlockings (Instructions 59 to 69, inclusive), Manual Part 138.

34. Electric car retarders must be maintained in accordance with Instructions for Interlockings (Instructions 70 to 76, inclusive), Manual Part 138.

35. Results of inspections and tests herein required and all other inspections and tests that may be required must be recorded as instructed.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Instructions for Car Retarder Systems, Manual Part 125.

(Revision of Instructions for Insulation Resistance)
A.A.R. SIGNAL SECTION INSTRUCTIONS.

INSULATION RESISTANCE*

1952

These instructions apply to the measurement of insulation resistance for wires, cables and associated equipment. They set forth general requirements representing recommended practice.

General.

1. Tests which may interfere with safe operation of trains must not be started until train movements have been fully protected. Temporary repairs, when required, must be made in such manner that safety of train operation will not be impaired. When repair, change or replacement is made, tests must be made immediately to determine that the apparatus functions as intended. When making tests, proper instruments must be used and it must be known that no unsafe conditions are set up by the application of testing equipment.

2. Electrostatic capacitance should be discharged by shorting the circuit, or by grounding the conductor, before and after making a test to avoid receiving a shock or damaging the apparatus.

3. Insulation resistance tests must be made as required when wires, cables or insulated parts are dry.

Instruments.

4. Direct reading instrument having a self-contained source of direct current test voltage must be used. Manufacturer's instructions for using instruments must be followed.

Range and voltage.

5. For circuits and apparatus of first, second and third voltage ranges (up to 250 volts) the instrument should be rated not less than zero to 20 megohms and 250 volts. For signal power cables and other circuits and apparatus of fourth and fifth voltage ranges (up to 660 volts and over), the instrument should be rated not less than zero to 100 megohms and 500 volts and may be rated as high as zero to 2,000 megohms and 1,000 volts.

Test leads.

6. Single-conductor stranded wire, having high quality insulation, with lugs for connecting to the instrument and suitable clips for connecting to apparatus under test should be used. They must be checked as follows:

- (a) Connect leads to the instrument binding posts, twist the insulated portion of the leads loosely together and see that terminals at the free ends are separated and clear of all objects.

* The term "as instructed" as used herein refers to individual railroad instructions.

Test leads.—Continued.

(b) Operate the instrument as directed and if the leads are properly insulated, the pointer should read infinity on the scale, indicating no leakage between leads.

(c) If any leakage exists, other leads must be obtained and tested in the same manner.

Electrostatic capacitance.

7. In testing any apparatus or circuit having an appreciable amount of electrostatic capacitance, a constant voltage type of instrument should be used and operated a sufficient length of time for the pointer to attain a maximum value before taking the reading.

Procedure.

8. Test each circuit separately or, where practicable, a group of circuits, all of which are electrically connected at the time of test, as follows:

(a) Circuit under test must be de-energized.

(b) Connect one terminal of instrument to one wire or part of the inter-connected circuit or circuits and the other terminal to ground and operate the instrument as directed.

(c) To determine the continuity of the circuit under test in a multiple cable, each wire should be tested to ground before measuring for leaks from one conductor to another.

(d) Multiple conductor cable must also be tested by connecting one terminal of the instrument to the conductor under test and the other terminal of instrument to all other conductors in the cable.

(e) If the circuit or circuits under test are found to have an insulation resistance lower than required for any one circuit in the group, the circuit or circuits must be segregated and test repeated until defect is found.

(f) When the insulation resistance is found to be lower than required, the defect must be repaired, or the wire or part replaced promptly and another test made.

(g) Test of insulation resistance should be made of complete circuit wherever possible so as to check all wires, cables and associated equipment.

9. The results of tests of insulation resistance must be recorded as instructed.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Instructions for Insulation Resistance, Manual Part 130.

(Revision of Instructions for Facing Point Locks Applied to Spring Switches)
A.A.R. SIGNAL SECTION INSTRUCTIONS.

FACING POINT LOCKS APPLIED TO SPRING SWITCHES*

1952

These instructions apply to the installation, maintenance and test of facing point locks applied to spring switches. They set forth general requirements representing recommended practice.

1. Maintenance, tests and repair work which may interfere with safe operation of trains must not be started until train movements have been fully protected. Temporary repairs or adjustments, when required, must be made in such manner that safety of train operation will not be impaired. When repair, adjustment, change or replacement is made, tests must be made immediately to determine that the apparatus functions as intended. When making tests of apparatus, proper instruments must be used and it must be known that no unsafe conditions are set up by the application of testing equipment.

2. Facing point lock mechanism, tie plates, gage plates and crank stand must be kept securely fastened to the ties.

3. Special rail stop must be securely fastened to the switch point and the switch should be free and in proper alignment so that the rail stop will bear positively against the stock rail when the switch is thrown slowly to the normal position by hand, and also return against the stock rail after the switch has been pried away by means of a bar inserted as near the stop as possible.

4. Connections operating the locking plunger must be kept tight and the end of plunger must have square edges.

5. Holes or notches in lock rods must have square edges and must be not more than $\frac{3}{16}$ inch larger than plunger.

6. Lock rods must be so maintained that when switch is operated by hand toward its normal position, the plunger will not enter the lock rod if the switch point is prevented by an obstruction from closing to within $\frac{1}{4}$ inch.

7. Point detector must be so maintained that when switch mechanism is locked in normal or reverse position, contacts cannot be opened by manually applying force at the closed switch point. Point detector circuit controller must be so maintained that the contacts will not assume the position corresponding to switch point closure if the switch point is prevented by an obstruction from closing to within $\frac{1}{4}$ inch where latch-out device is not used and to within $\frac{3}{8}$ inch where latch-out device is used.

8. Tests must be made, as instructed, to determine that end of locking plunger is withdrawn from the lock rod without binding.

9. Locking plunger contacts must be so maintained that disconnection of the locking plunger connection at its point of attachment to the switch, when

* The term "as instructed" as used herein refers to individual railroad instructions.

the switch and switch operating mechanism are in normal position, must either:

(a) Prevent contacts from assuming the position indicating point closure, or

(b) Operate other contacts to indicate separately that plunger has over-traveled.

10. Facing point mechanism must be maintained and adjusted in accordance with manufacturer's instructions unless they conflict with any other instructions, in which case proper authority must be consulted for correct procedure.

11. Results of inspections and tests herein required and all other inspections and tests that may be required must be recorded as instructed.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Instructions for Facing Point Locks Applied to Spring Switches,
Manual Part 159.

COOPERATIVE REPORT

AMERICAN STANDARDS ASSOCIATION DEFINITIONS OF ELECTRICAL TERMS PROJECT C42—SUBGROUP 8

F. Youngwerth, Representative

Advance copies of Sections 46, 51 and 56 of American Standards Association Group C42, definitions of electrical terms, were reviewed and screened against A.A.R. Signal Section Manual Part 55 and against definitions as contained in the Rules, Standards and Instructions of the Interstate Commerce Commission.

Revised drafts of aforementioned sections were submitted to the Secretary of the A.S.A. for printing and distribution to members of A.S.A. Sectional Committee C42, certain Chairmen of A.I.E.E. Technical Committees, Chairmen of other A.S.A. Sectional Committees and the National Security Resource Board for their review and comment. To date printed copies for final checking have not been received.

Your representative has received printed copies of drafts from 15 other A.S.A. subgroups. These drafts have been reviewed and comments referred to the appropriate Subcommittee Chairmen for their further consideration.

Action Recommended

Acceptance as information.

COMMITTEE VI—DESIGNS

Personnel

W. G. Brown, Chairman

C. J. R. Taylor, Vice-Chairman

H. Alexander	H. P. Schmidt
R. I. Becksted	P. E. Snead
E. F. Brown	D. B. Thomas
W. A. Ford	C. C. Thorn
B. C. Hollowell	T. W. Tizzard
W. T. Lewis	C. H. Tobin
J. C. Lummis	C. N. Tymeson
J. M. Rice	A. J. Yarrell

Signal Section, A.A.R.:

The following outline of work has been assigned:

1. Revision of Manual.
2. Indexing signal literature.
3. Designs.
4. Specifications and drawings covering reflector lenses and similar devices for signals and signs, collaborating with Committee VIII.
5. Simplification of sizes and kinds of electric lamps for signal purposes, cooperating with Purchases and Stores Division, A.A.R.
6. Specification for concrete for shop precast and poured in place foundations.
7. Design a universal switch adjustment bracket.
8. Design a universal adjustment bracket for application of lock rod to front rod.
9. Investigate and report on means and methods for the improvement of incandescent electric lamps used in signaling, collaborating with Committee I.
10. Design an electric switch lamp.
11. Specifications for plain and spring lock washers.

The Committee submits for consideration, reports on the following subjects*:

1. Revised drawings.
Revision of Specification 51-49, Manual Part 91.
Revision of Specification 231-50, Manual Part 237.
3. New drawings.
Cooperative report. American Standards Association—Standardization and Unification of Screw Threads—Project B1.

* Suggestions or criticisms should be submitted in writing to the Chairman of the Committee on or before September 1, 1952.

Information

Specifications, etc., of other organizations referred to in the report of this Committee may be procured from the following:

A.S.A.—American Standards Association, 70 E. 45 St., New York 17, N. Y.
A.S.T.M.—American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.

Disposition of 1951 Letter Ballot Subjects

The following subjects presented by Committee VI at the 1951 Annual Meeting were submitted to letter ballot and officially approved:

Specification 231-51—"No Right Turn"—"No Left Turn" Illuminated Sign—Now in Manual Part 237.

Specification 155-51—Railroad Highway Grade Crossing Signs—Now in Manual Part 44.

Specification 255-51—Reflex-Reflecting Sheet Material—Now in Manual Part 276.

A.A.R. Sig. Sec. 1642F—Railroad Crossing Sign—90 Degree Reflector Type for 4 to 8-Inch Pipe—Assembly—Now in Drawing Section of Manual.

A.A.R. Sig. Sec. 1645E—Number of Tracks Sign—Reflector Type for 4 to 8-Inch Pipe—Assembly—Now in Drawing Section of Manual.

A.A.R. Sig. Sec. 1646E—Stop on Red Signal Sign—Reflector Type for 4 to 8-Inch Pipe—Assembly—Now in Drawing Section of Manual.

A.A.R. Sig. Sec. 1648E—Stop When Swinging Sign—Reflector Type for 4 to 8-Inch Pipe—Assembly—Now in Drawing Section of Manual.

A.A.R. Sig. Sec. 1692D—Railroad Crossing Sign—50 Degree Reflector Type for 4 to 8-Inch Pipe—Assembly—Now in Drawing Section of Manual.

A.A.R. Sig. Sec. 1643F—Front Plates for Railroad Crossing Sign—90 Degree Reflector Unit Type—Details—Now in Drawing Section of Manual.

A.A.R. Sig. Sec. 1693E—Front Plates for Railroad Crossing Sign—50 Degree Reflector Unit Type—Details—Now in Drawing Section of Manual.

A.A.R. Sig. Sec. 1702B—Front and Back Plates for Stop on Red Signal Sign—Reflector Unit Type—Details—Now in Drawing Section of Manual.

A.A.R. Sig. Sec. 1703B—Front and Back Plates for Stop When Swinging Sign—Reflector Unit Type—Details—Now in Drawing Section of Manual.

A.A.R. Sig. Sec. 1700B—Front and Back Plates for Number of Tracks Sign—Reflector Unit Type—Details—Now in Drawing Section of Manual.

A.A.R. Sig. Sec. 1462B—Highway Crossing Signal—Flashing Light Type with Extended Lights and Pedestal Mounted Gate—Assembly—Now in Drawing Section of Manual.

A.A.R. Sig. Sec. 1489E—Highway Crossing Signal—Flashing Light Type with Suspended Lights and Mast Mounted Gate—Assembly—Now in Drawing Section of Manual.

A.A.R. Sig. Sec. 1691E—Highway Crossing Sign—50 Degree Reflector Type—Assembly—Now in Drawing Section of Manual.

A.A.R. Sig. Sec. 1651F—Highway Crossing Signal—Wig-Wag Type with Stop When Swinging Sign—Assembly—Now in Drawing Section of Manual.

A.A.R. Sig. Sec. 1652F—Highway Crossing Signal—Wig-Wag Type with Stop Sign—Assembly—Now in Drawing Section of Manual.

- A.A.R. Sig. Sec. 1653F—Highway Crossing Signal—Flashing Light Type with Stop on Red Signal Sign—Assembly—Now in Drawing Section of Manual.
- A.A.R. Sig. Sec. 1654F—Highway Crossing Signal—Flashing Light Type with Stop Sign—Assembly—Now in Drawing Section of Manual.
- A.A.R. Sig. Sec. 1686F—Highway Crossing Signal—Flashing Light Type, 6 Ft. and 8 Ft. Cantilever Span—Assembly—Now in Drawing Section of Manual.
- A.A.R. Sig. Sec. 1688D—Highway Crossing Signal—Flashing Light Type, 10 Ft. and 12 Ft. Cantilever Span—Assembly—Now in Drawing Section of Manual.
- A.A.R. Sig. Sec. 1705A—Front Plates for 50 Degree Railroad Crossing Sign—Reflex-Reflecting Sheet Type for Back Plates 17041 and 17042—Details—Now in Drawing Section of Manual.
- A.A.R. Sig. Sec. 1706A—Front Plates for 90 Degree Railroad Crossing Sign—Reflex-Reflecting Sheet Type for Back Plates 17011 and 17012—Details—Now in Drawing Section of Manual.
- A.A.R. Sig. Sec. 1707A—Front Plates for Number of Tracks Sign—Reflex-Reflecting Sheet Type for Back Plate 17001—Details—Now in Drawing Section of Manual.
- A.A.R. Sig. Sec. 1708A—Front Plate for Stop on Red Signal Sign—Reflex-Reflecting Sheet Type for Back Plate 17021—Detail—Now in Drawing Section of Manual.
- A.A.R. Sig. Sec. 1709A—Front Plate for Stop When Swinging Sign—Reflex-Reflecting Sheet Type for Back Plate 17031—Detail—Now in Drawing Section of Manual.
- A.A.R. Sig. Sec. 1715A—50 Degree Railroad Crossing Sign—Reflex-Reflecting Sheet Type for 4 to 8-Inch Pipe—Assembly—Now in Drawing Section of Manual.
- A.A.R. Sig. Sec. 1716A—Plates for 50 Degree Railroad Crossing Sign—Reflex-Reflecting Sheet Type—Details—Now in Drawing Section of Manual.
- A.A.R. Sig. Sec. 1717A—90 Degree Railroad Crossing Sign—Reflex-Reflecting Sheet Type for 4 to 8-Inch Pipe—Assembly—Now in Drawing Section of Manual.
- A.A.R. Sig. Sec. 1718A—Plates for 90 Degree Railroad Crossing Sign—Reflex-Reflecting Sheet Type—Details—Now in Drawing Section of Manual.
- A.A.R. Sig. Sec. 1719A—Number of Tracks Sign—Reflex-Reflecting Sheet Type for 4 to 8-Inch Pipe—Details and Assembly—Now in Drawing Section of Manual.
- A.A.R. Sig. Sec. 1720A—Stop on Red Signal Sign—Reflex-Reflecting Sheet Type for 4 to 8-Inch Pipe—Details and Assembly—Now in Drawing Section of Manual.
- A.A.R. Sig. Sec. 1721A—Stop When Swinging Sign—Reflex-Reflecting Sheet Type for 4 to 8-Inch Pipe—Details and Assembly—Now in Drawing Section of Manual.
- A.A.R. Sig. Sec. 1712A—Letters—Rounded Type—5½ Inch—Details—Now in Drawing Section of Manual.
- A.A.R. Sig. Sec. 1713A—Letters—Rounded Type—4 Inch—Details—Now in Drawing Section of Manual.
- A.A.R. Sig. Sec. 1714A—Numerals—Rounded Type—5½ Inch—Details—Now in Drawing Section of Manual.

REVISED DRAWINGS

- A.A.R. Sig. Sec. 1055E—Switch-Rod Insulation.
Arranged to conform to A.R.E.A. Plan No. 222.
- A.A.R. Sig. Sec. 1245B—Pinnacles—for 4, 5, 6 and 8 Inch Mast—Details and Assemblies.
Arranged to include pinnacles for 6 and 8-inch pipe.
- A.A.R. Sig. Sec. 1271B—Ball Studs—for Switch Circuit Controller—Details and Assemblies.
- A.A.R. Sig. Sec. 1272B—Ball Socket Screw Jaw—for Switch Circuit Controller—Details and Assemblies.
Titles and details changed in accordance with latest practice.
- A.A.R. Sig. Sec. 1364E—Ladder Platforms—Details and Assemblies.
- A.A.R. Sig. Sec. 1399D—Low Target Stand—Details and Assembly.
- A.A.R. Sig. Sec. 1447B—Base for 5 Inch Mast—For Heavy Loading.
Details changed in accordance with latest practice.
- A.A.R. Sig. Sec. 1463B—Cross-Arm for Extended Lights—for Flashing Light Highway Crossing Signal with Pedestal Mounted Gate—Assembly.
- A.A.R. Sig. Sec. 1468B—Cross-Arm for Suspended Lights—for Flashing Light Highway Crossing Signal with Mast Mounted Gate—Assemblies.
Titles and details changed in accordance with latest practice.
- A.A.R. Sig. Sec. 1489F—Highway Crossing Signal—Flashing Light Type with Suspended Lights and Mast Mounted Gate—Assembly.
Details changed in accordance with latest practice.
- A.A.R. Sig. Sec. 1491E—Highway Crossing Gate Roadway Arm—for Mast Mounting.
- A.A.R. Sig. Sec. 1492B—Highway Crossing Gate Sidewalk Arm—for Mast Mounting.
- A.A.R. Sig. Sec. 1647E—Single Adapter Clamp—for Signs—4 to 8 Inch Pipe—Details.
- A.A.R. Sig. Sec. 1656E—Cross-Arm for Suspended Lights for Flashing Light Highway Crossing Signals without Gates—4 to 8 Inch Pipe—Assemblies.
Titles and details changed in accordance with latest practice.
- A.A.R. Sig. Sec. 1657E—Cross-Arms—for Flashing Light Highway Crossing Signals—4 to 8 Inch Pipe—Details.
- A.A.R. Sig. Sec. 1696B—Extension Brackets for Crossing Signs.
- A.A.R. Sig. Sec. 1542B—Incandescent Electric Lamps—Bases.
Details changed in accordance with latest practice.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

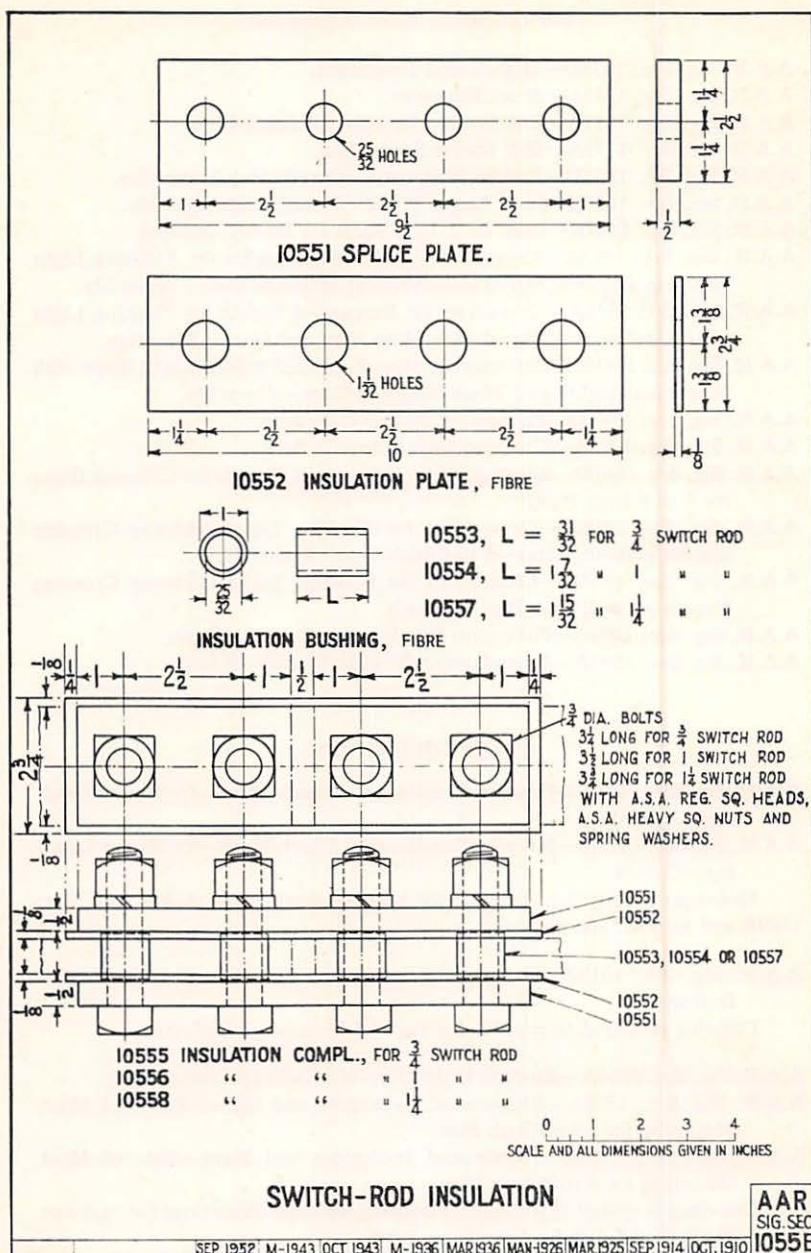
- A.A.R. Sig. Sec. 1055D—Switch-Rod Insulation.
- A.A.R. Sig. Sec. 1245A—Short Pinnacles.
- A.A.R. Sig. Sec. 1271A—Ball Studs—Details and Assemblies.
- A.A.R. Sig. Sec. 1272A—Ball Socket Screw Jaw.
- A.A.R. Sig. Sec. 1364D—Ladder Platforms—Details and Assemblies.
- A.A.R. Sig. Sec. 1399C—Low Target Stand—Details and Assembly.
- A.A.R. Sig. Sec. 1447A—Base for 5-Inch Mast for Heavy Loading.
- A.A.R. Sig. Sec. 1463A—Cross-Arm for Extended Lights for Flashing Light Highway Crossing Signal with Pedestal Mounted Gate—Assembly.
- A.A.R. Sig. Sec. 1468A—Cross-Arm for Suspended Lights for Flashing Light Highway Crossing Signal with Mast Mounted Gate—Assembly.
- A.A.R. Sig. Sec. 1489E—Highway Crossing Signal—Flashing Light Type with Suspended Lights and Mast Mounted Gate—Assembly.
- A.A.R. Sig. Sec. 1491D—Highway Crossing Gate Arm.
- A.A.R. Sig. Sec. 1492A—Crossing Gate Sidewalk Arm.
- A.A.R. Sig. Sec. 1647D—Single Adapter Clamp and Details for Crossing Signs for 4 to 8-Inch Pipe.
- A.A.R. Sig. Sec. 1656D—Cross-Arms for Flashing Light Highway Crossing Signals without Gates—4 to 8 Inch Pipe—Assemblies.
- A.A.R. Sig. Sec. 1657D—Cross-Arms for Flashing Light Highway Crossing Signals—4 to 8 Inch Pipe—Details.
- A.A.R. Sig. Sec. 1696A—Extension Brackets for Crossing Signs.
- A.A.R. Sig. Sec. 1542A—Incandescent Electric Lamps—Bases.

NEW DRAWINGS

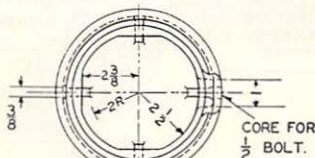
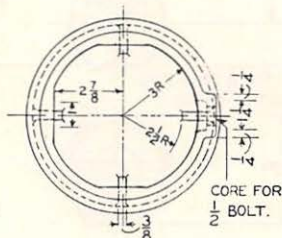
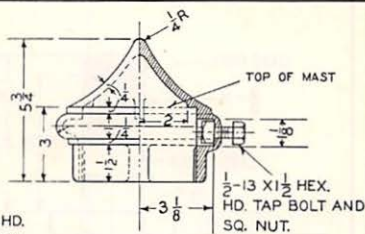
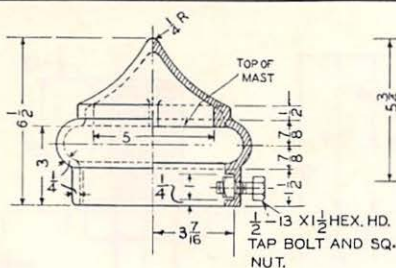
- A.A.R. Sig. Sec. 1471A—Junction Box Base for 5 Inch Mast—for Heavy Loading—Assembly.
- A.A.R. Sig. Sec. 1472A—Junction Box Base for 5 Inch Mast—for Heavy Loading—Details.
- Drawings prepared to provide for base as specified on A.A.R. Sig. Sec. 1489F and as otherwise required.
- A.A.R. Sig. Sec. 1513A—Take or Leave Siding Roundel—for Illuminated Indicator.
- Drawing prepared to provide for roundel for modern indicator.
- A.A.R. Sig. Sec. 1514A—Electric Light Unit—for Indicators and Signs.
- A.A.R. Sig. Sec. 1515A—Illuminated Indicators and Signs—Front of Mast Mounting for 4 to 8 Inch Pipe.
- A.A.R. Sig. Sec. 1516A—Illuminated Indicators and Signs—Side of Mast Mounting for 4 to 8 Inch Pipe.
- Drawings prepared to provide for housing unit and mountings for "take or leave siding" roundel and others as required.

Action Recommended

Acceptance for submission to letter ballot.

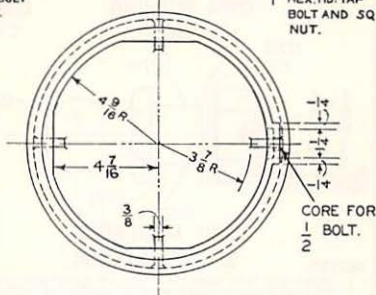
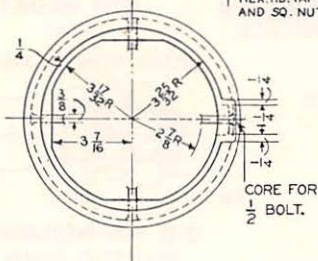
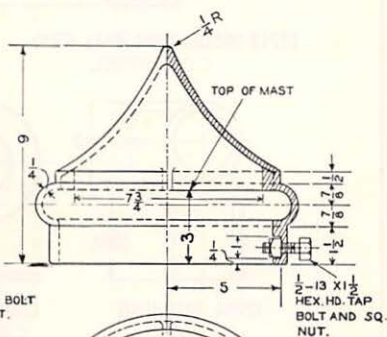
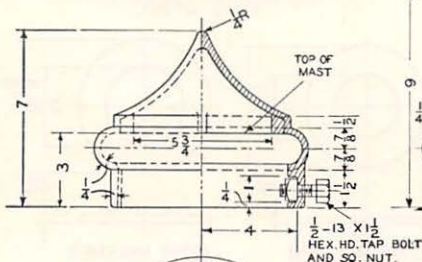


Switch-rod insulation shall conform to detail 3001, A.R.E.A. Plan No. 222.



12452 4 INCH PINNACLE

12451 5 INCH PINNACLE



12453 6 INCH PINNACLE

12454 8 INCH PINNACLE

0 3 6
SCALES AND ALL DIMENSIONS GIVEN IN INCHES

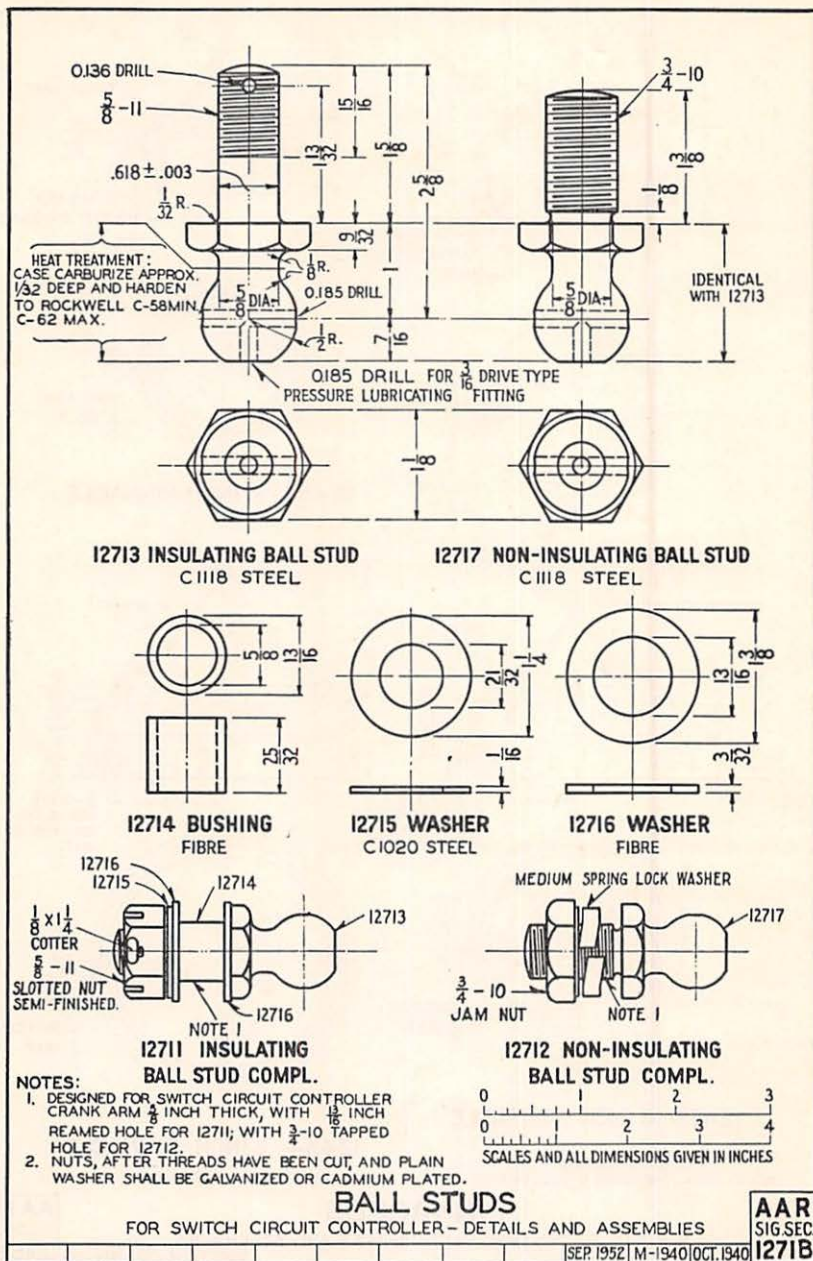
MATERIAL: CAST IRON

PINNACLES

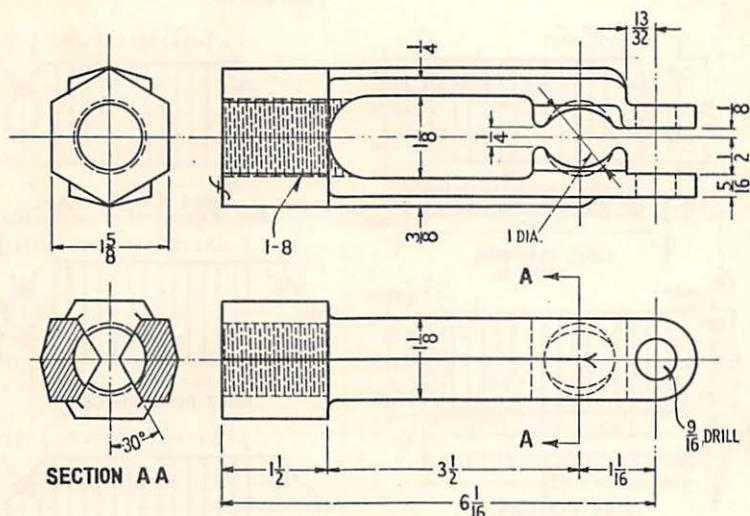
FOR 4-5-6 AND 8 INCH MAST—DETAILS AND ASSEMBLIES

A.A.R.
SIG. SEC.
1245 B

Cast iron shall be Class 20 in accordance with Specification for Gray Iron Castings, Manual Part 88.



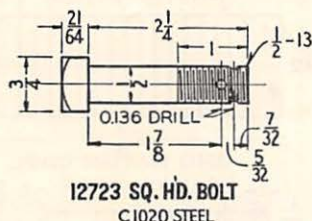
Fibre shall be in accordance with Specification 13, Manual Part 58; Spring lock washers shall be of carbon steel (A.S.A. current Specification B27.1 is preferred, where practicable); Nuts and threads shall be in accordance with Specifications for Bolts, Nuts and Threads, Manual Part 17.



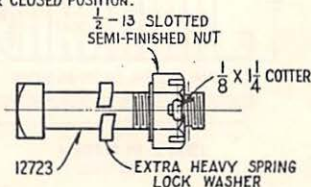
12722 ADJUSTABLE SOCKET SCREW JAW

MALLEABLE IRON — CLOSED POSITION SHOWN

NOTE: JAW MAY BE FURNISHED IN OPEN OR CLOSED POSITION.



12723 SQ. HD. BOLT
C1020 STEEL

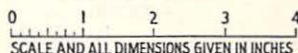


12724. SQ. HD. BOLT COMPL.

12721 ADJUSTABLE SOCKET SCREW JAW COMPL. WITH BOLT 12724.

NOTE:

NUT AND BOLT, AFTER THREADS HAVE BEEN CUT AND COTTER HOLES DRILLED, SHALL BE GALVANIZED OR CADMIUM PLATED



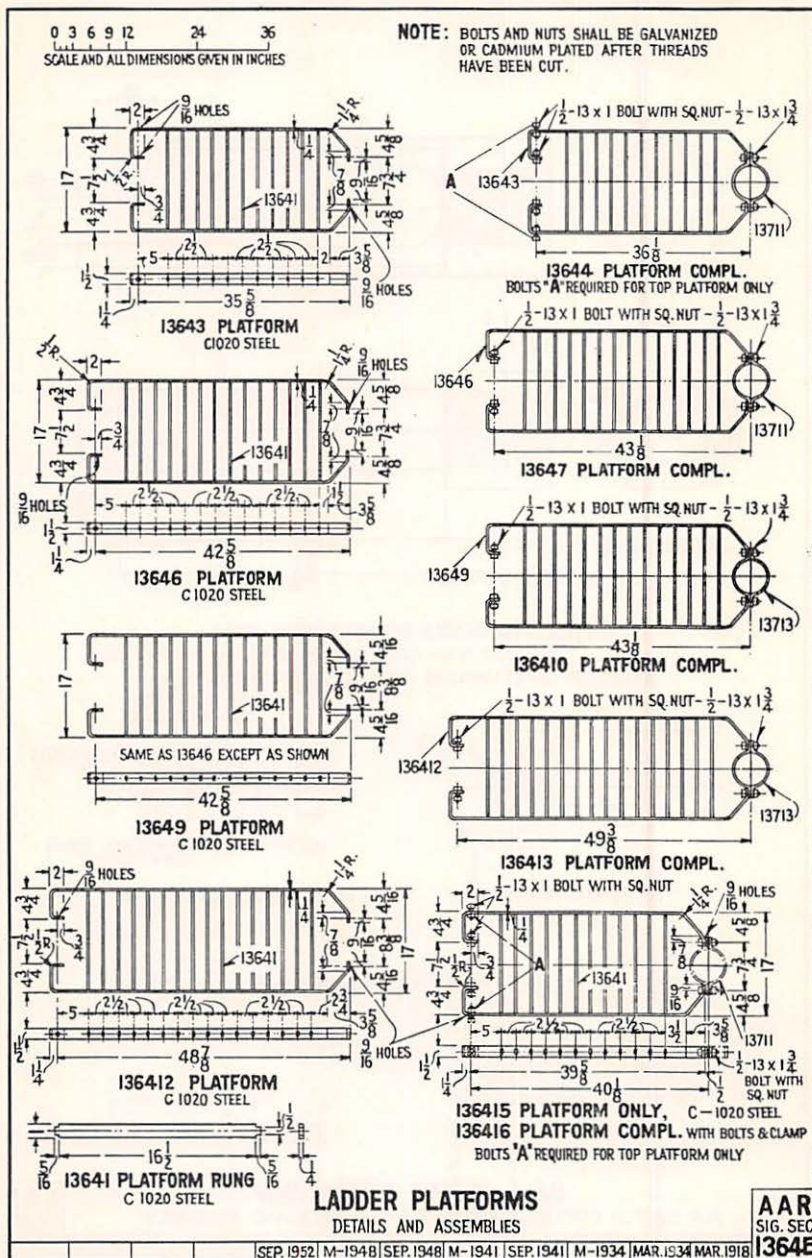
BALL SOCKET SCREW JAW

FOR SWITCH CIRCUIT CONTROLLER — DETAILS AND ASSEMBLY

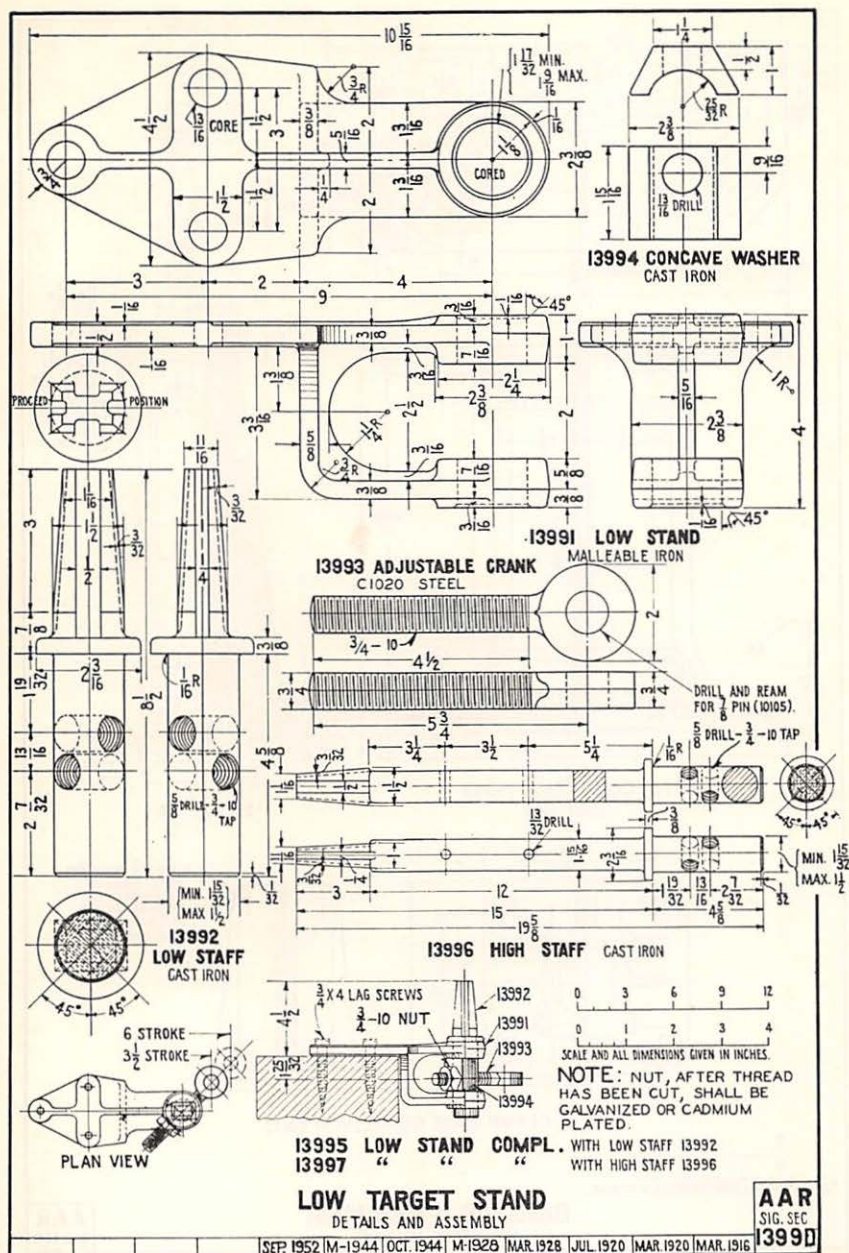
AAR
SIG. SEC.

SEP. 1952 | M-1940 | OCT. 1940 | **12722B**

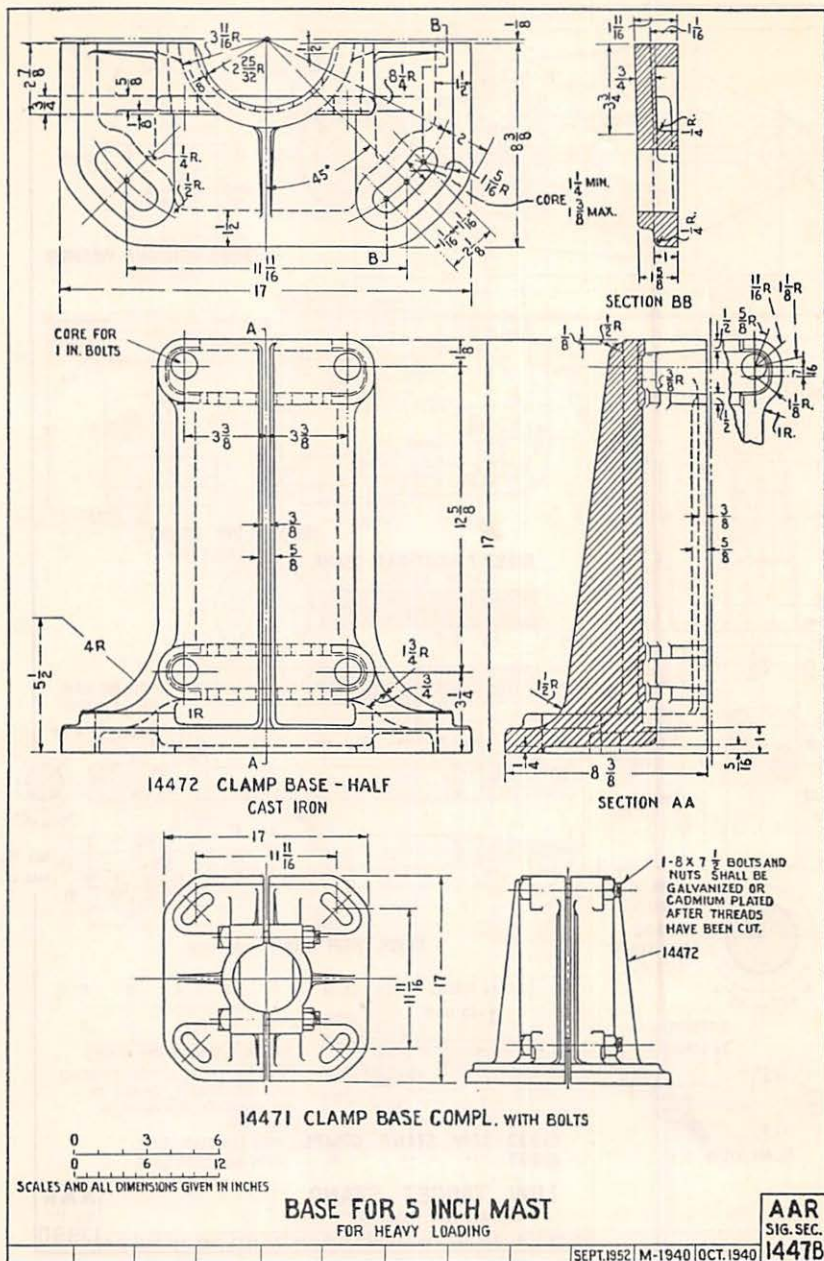
Malleable iron shall be Grade 32510 in accordance with Specification for Malleable Iron Castings, Manual Part 89; Spring lock washers shall be of carbon steel (A.S.A. current Specification B27.1 is preferred, where practicable); Bolts, nuts and threads shall be in accordance with Specifications for Bolts, Nuts and Threads, Manual Part 17; Painting shall be in accordance with Specification 120, Manual Part 110.



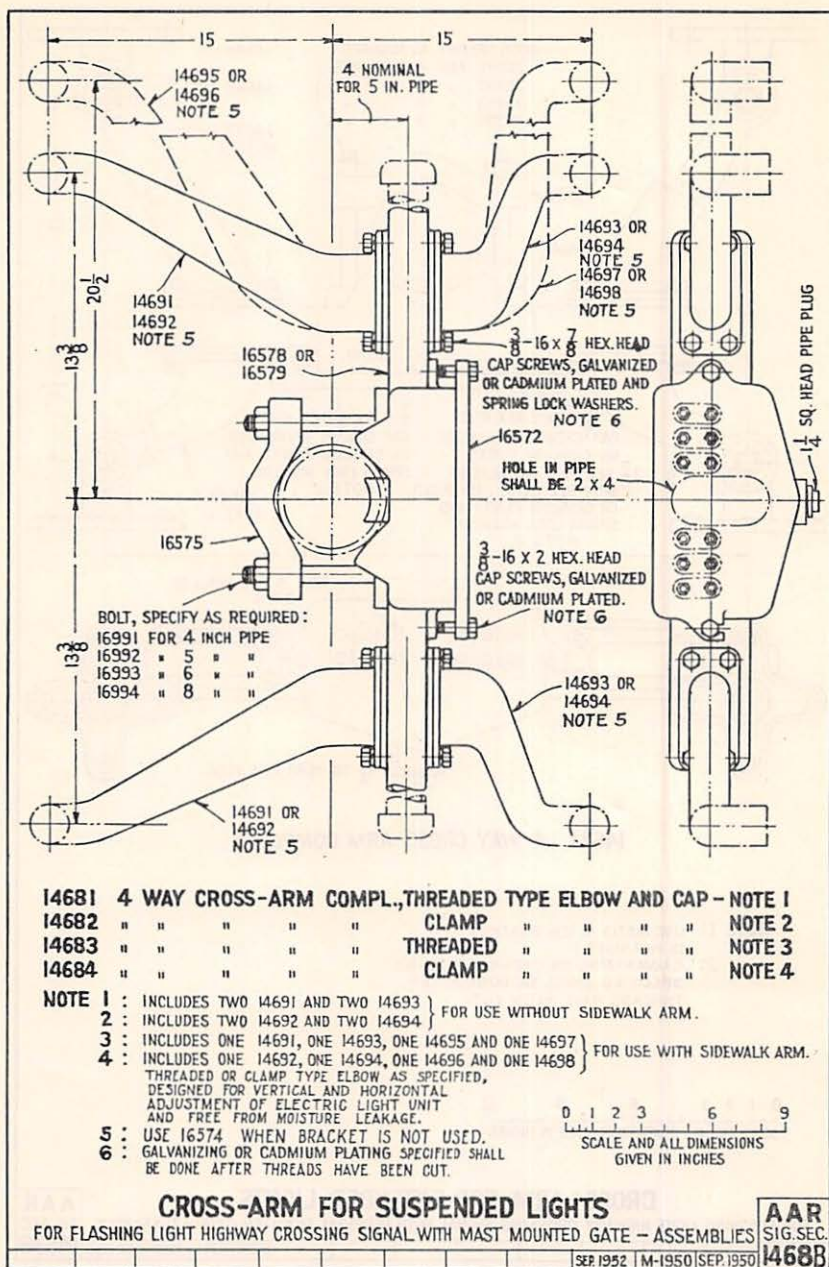
Bolts, nuts and threads shall be in accordance with Specifications for Bolts, Nuts and Threads, Manual Part 17; Painting shall be in accordance with Specification 120, Manual Part 110.



Cast iron shall be Class 20 in accordance with Specification for Gray Iron Castings, Manual Part 88; Malleable iron shall be Grade 32510 in accordance with Specification for Malleable Iron Castings, Manual Part 89; Nut and threads shall be in accordance with Specifications for Bolts, Nuts and Threads, Manual Part 17; Painting shall be in accordance with Specification 120, Manual Part 110.



Cast iron shall be in accordance with Specification for Gray Iron Castings, Manual Part 88; Bolts, nuts and threads shall be in accordance with Specifications for Bolts, Nuts and Threads, Manual Part 17; Painting shall be in accordance with Specification 120, Manual Part 110.



Bolts, nuts and threads shall be in accordance with Specifications for Bolts, Nuts and Threads, Manual Part 17; Spring lock washers shall be of carbon steel (A.S.A. current Specification B27.1 is preferred, where practicable).

NOTE 1 : ELECTRIC LIGHT UNITS AAR SIG. SEC.
SPEC. 236, MANUAL PART 263.

NOTE 2 : 16961 WITH SIDEWALK ARM ON TRACK SIDE
AS SHOWN.

NOTE 3 : 16963 WITH SIDEWALK ARM ON FIELD SIDE.
1/2 X 3 1/2 BOLT WITH NUT, PLAIN WASHER
AND EXTRA HEAVY SPRING LOCK WASHER.
BOLT, NUT AND PLAIN WASHER SHALL BE
GALVANIZED OR CADMIUM PLATED AFTER
THREADS HAVE BEEN CUT.

16404 MODIFIED,
16428, 16429,
164210 OR 17171

16444, 164512, 164513,
164514 OR 17191

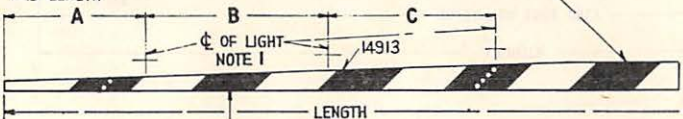
14681, 14682, 14683. OR 14684

ELECTRIC LIGHT UNITS AAR SIG. SEC.
SPEC. 190, MANUAL PART 166 OR
AAR SIG. SEC. SPEC. 232, MANUAL
PART 244.

16467, 16468.
16469 OR 17201

ELECTRIC MOTOR MECHANISM AND
GATE ARM AAR SIG. SEC. SPEC. 139,
MANUAL PART 194.

SPECIFY DIMENSIONS A-B-C
AND LENGTH



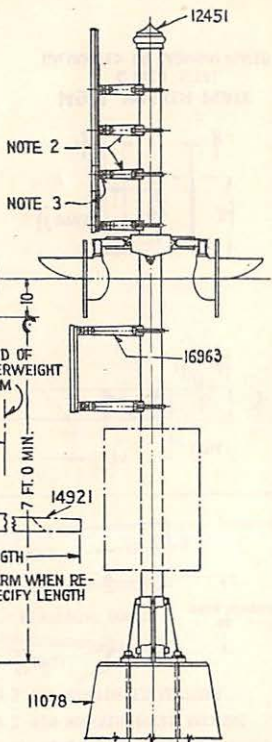
3 FT. 0 MIN.
4 FT. 0 MAX.

TOP OF FOUNDATION
6 IN. ABOVE CROWN OF HIGHWAY

5 INCH PIPE
12 FT. 10 LONG
14711, 14712 OR 14471

SIDEWALK ARM WHEN RE-
QUIRED, SPECIFY LENGTH

0 12 24 36 48 60 72
SCALE AND ALL DIMENSIONS GIVEN IN INCHES
UNLESS OTHERWISE INDICATED.



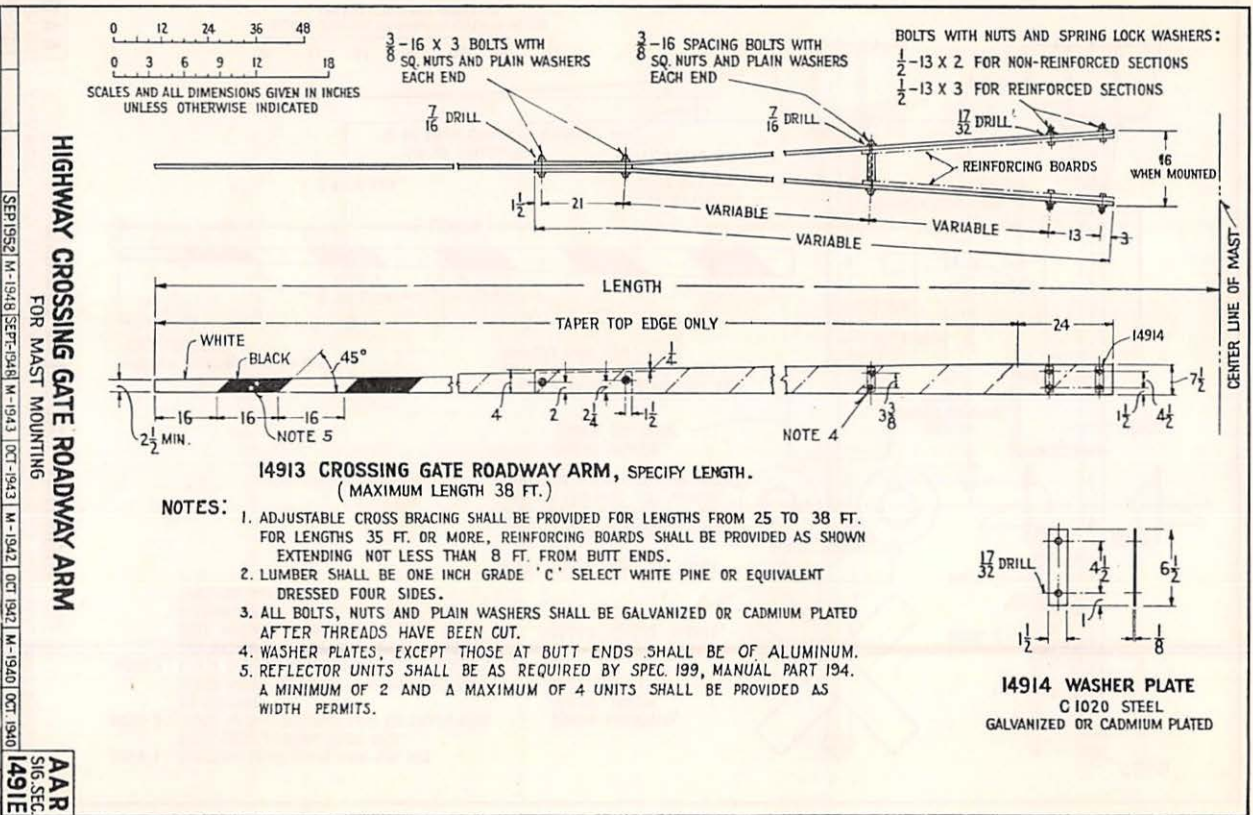
HIGHWAY CROSSING SIGNAL

FLASHING LIGHT TYPE WITH SUSPENDED LIGHTS AND MAST MOUNTED GATE—ASSEMBLY

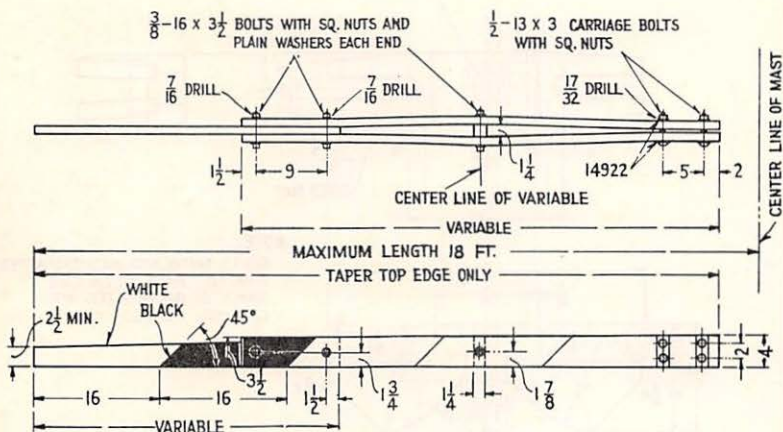
SEP 1952 M-1951 SEP 1951 M-1950 SEP 1950 M-1947 SEP 1947 M-1945 OCT 1945 M-1943 OCT 1943

AAR
SIG. SEC.
1489F

Bolts, nuts and threads shall be in accordance with Specifications for Bolts, Nuts and Threads, Manual Part 17; spring lock washers shall be of carbon steel (A.S.A. current Specification B27.1 is preferred, where practicable).



Bolts, nuts and threads shall be in accordance with Specifications for Bolts, Nuts and Threads, Manual Part 17; Spring lock washers shall be of carbon steel (A.S.A. current Specification B27.1 is preferred, where practicable); Painting shall be in accordance with Specification 120, Manual Part 110.

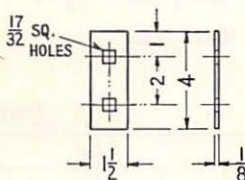
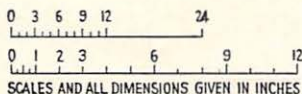


14921 CROSSING GATE SIDEWALK ARM, SPECIFY LENGTH.

NOTES:

LUMBER SHALL BE ONE INCH GRADE 'C' SELECT WHITE PINE OR EQUIVALENT DRESSED FOUR SIDES.

ALL BOLTS, NUTS AND PLAIN WASHERS SHALL BE GALVANIZED OR CADMIUM PLATED AFTER THREADS HAVE BEEN CUT.



14922 WASHER PLATE

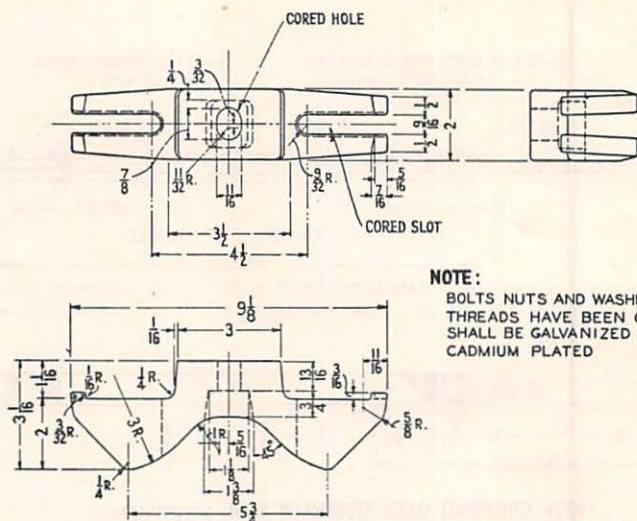
C1020 STEEL
GALVANIZED OR CADMIUM PLATED
4 REQ'D.

**HIGHWAY CROSSING GATE SIDEWALK ARM
FOR MAST MOUNTING**

A.A.R.
SIG. SEC.
14928

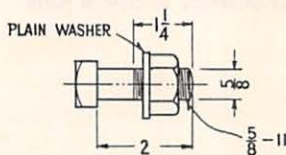
SEP. 1952 M-1949 SEP. 1949

Bolts, nuts and threads shall be in accordance with Specifications for Bolts, Nuts and Threads, Manual Part 17; Painting shall be in accordance with Specification 120, Manual Part 110.

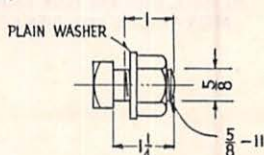
**NOTE:**

BOLTS NUTS AND WASHERS AFTER
THREADS HAVE BEEN CUT
SHALL BE GALVANIZED OR
CADMIUM PLATED

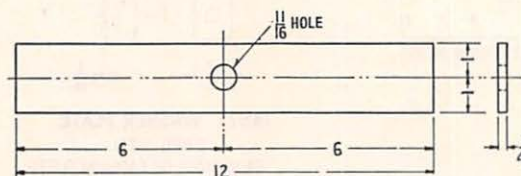
16477 ADAPTER CLAMP,
CAST IRON.



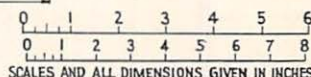
16474 BOLT.



16475 BOLT.



16473 STRAP,
C1020 STEEL



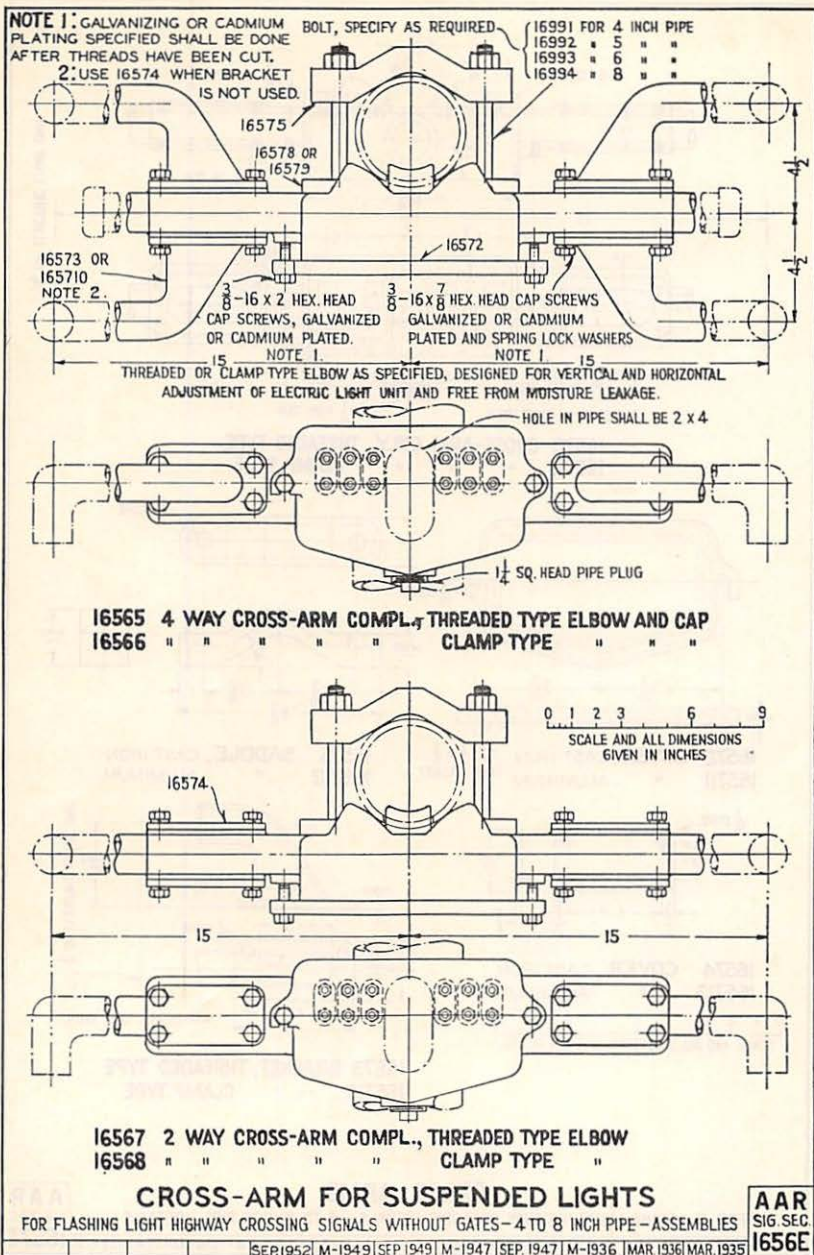
SCALES AND ALL DIMENSIONS GIVEN IN INCHES

SINGLE ADAPTER CLAMP
FOR SIGNS - 4 TO 8 INCH PIPE—DETAILS

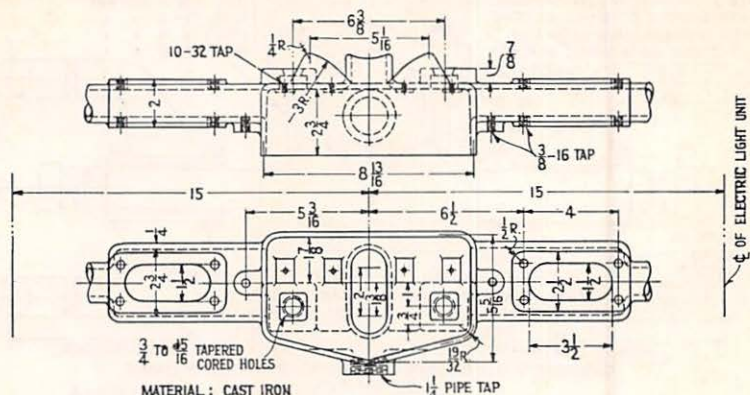
AAR
SIG. SEC.

1647E

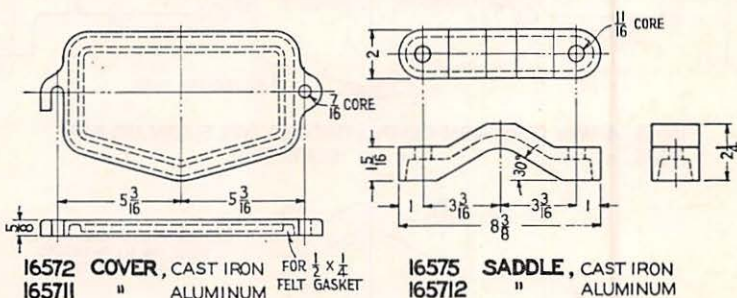
Cast iron shall be Class 20 in accordance with Specification for Gray Iron Castings, Manual Part 88; Bolts, nuts and threads shall be in accordance with Specifications for Bolts, Nuts and Threads, Manual Part 17; Painting shall be in accordance with Specification 120, Manual Part 110.



Bolts, nuts and threads shall be in accordance with Specifications for Bolts, Nuts and Threads, Manual Part 17. Spring lock washers shall be of carbon steel (A.S.A. current Specification B27.1 is preferred, where practicable).

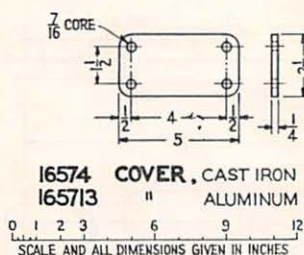


16578 CROSS-ARM ONLY, THREADED TYPE
16579 " " " CLAMP TYPE

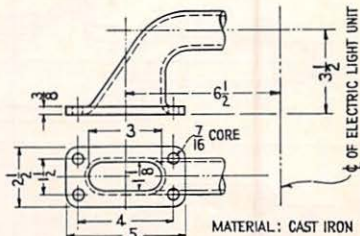


16572 COVER, CAST IRON
165711 " ALUMINUM

16575 SADDLE, CAST IRON
165712 " ALUMINUM



16574 COVER, CAST IRON
165713 " ALUMINUM



16573 BRACKET, THREADED TYPE
165710 " CLAMP TYPE

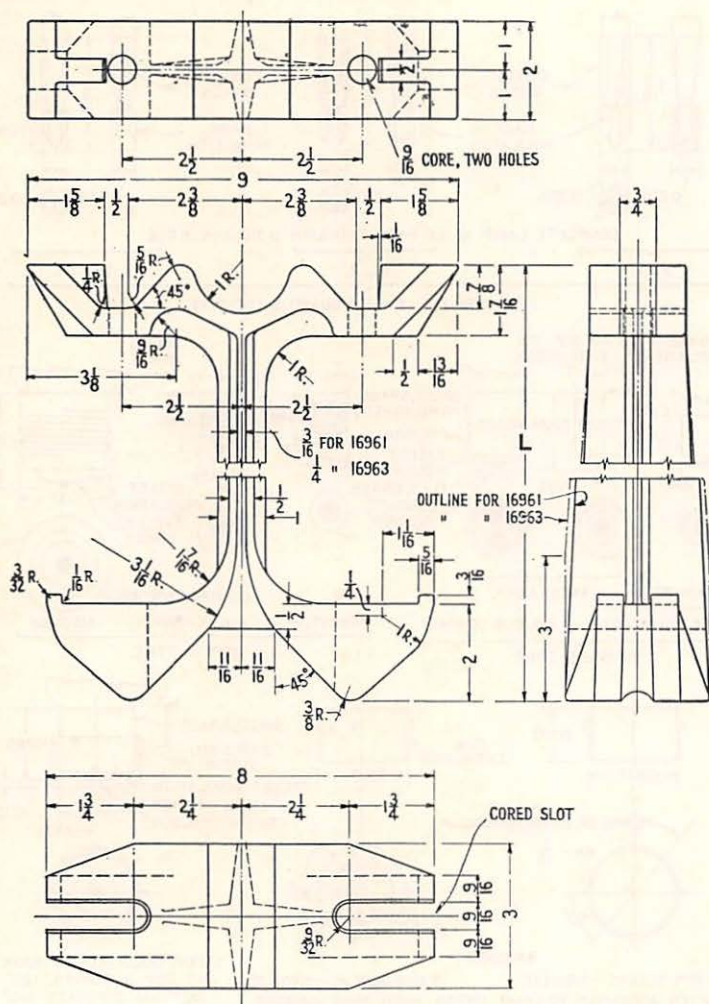
CROSS-ARMS

FOR FLASHING LIGHT HIGHWAY CROSSING SIGNALS—4 TO 8 INCH PIPE—DETAILS

SEP. 1952 | M-1949 | SEP. 1949 | M-1947 | SEP. 1947 | M-1936 | MAR. 1936 | MAR. 1935

A.A.R.
SIG. SEC.
1657E

Cast iron shall be Class 20 in accordance with Specification for Gray Iron Castings, Manual Part 88; Threads shall be in accordance with Specifications for Bolts, Nuts and Threads, Manual Part 17; Cast aluminum shall be A.S.T.M. No. B 26, alloy number and treatment as required; Aluminum parts shall be given an approved paint treatment after surfaces are treated to provide suitable paint adherence. When practicable, the surface treatment shall be approved corrosion-inhibiting type. Painting shall be in accordance with Specification 120, Manual Part 110.



16961 EXTENSION BRACKET L = 9 INCHES
16963 " " L = 16 1/4 "

CAST IRON

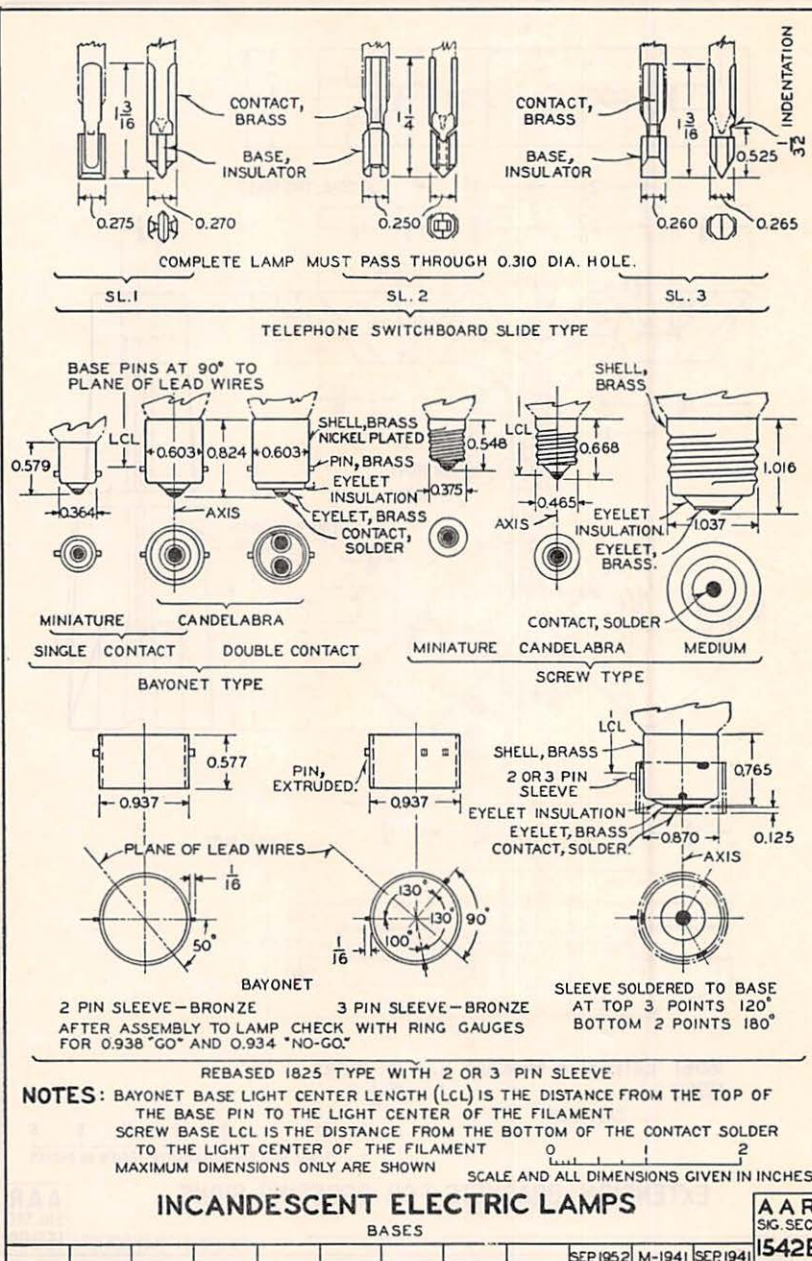
0 1 2 3 4 5 6
SCALE AND ALL DIMENSIONS GIVEN IN INCHES

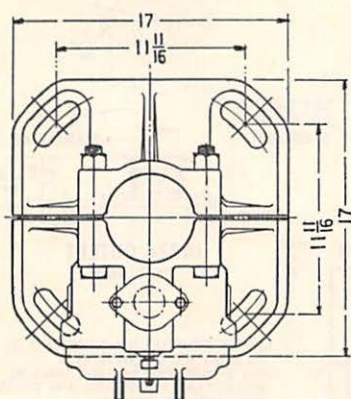
EXTENSION BRACKETS FOR CROSSING SIGNS

AAR
SIG. SEC.
16968

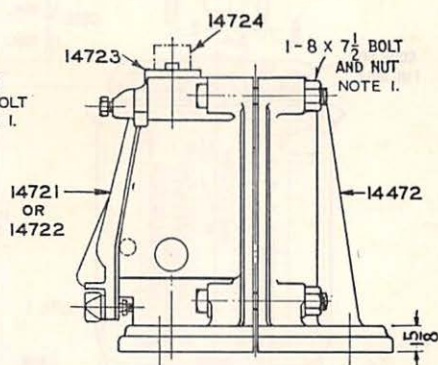
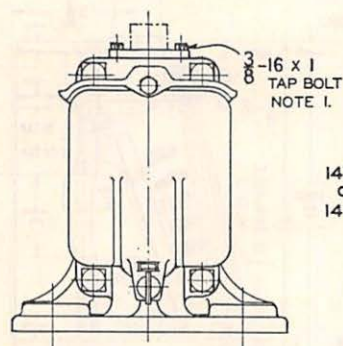
SEP. 1952 M-1947 SEP. 1947

Cast iron shall be in accordance with Specification for Gray Iron Castings, Manual Part 88;
Painting shall be in accordance with Specification 120, Manual Part 110.





NOTE 1. GALVANIZE OR CADMIUM PLATE
AFTER THREADS HAVE BEEN CUT.



14711	JUNCTION BOX CLAMP BASE COMPL. WITH	14721	AND	14723
14712	"	"	"	14722
14713	"	"	"	14721
14714	"	"	"	14722

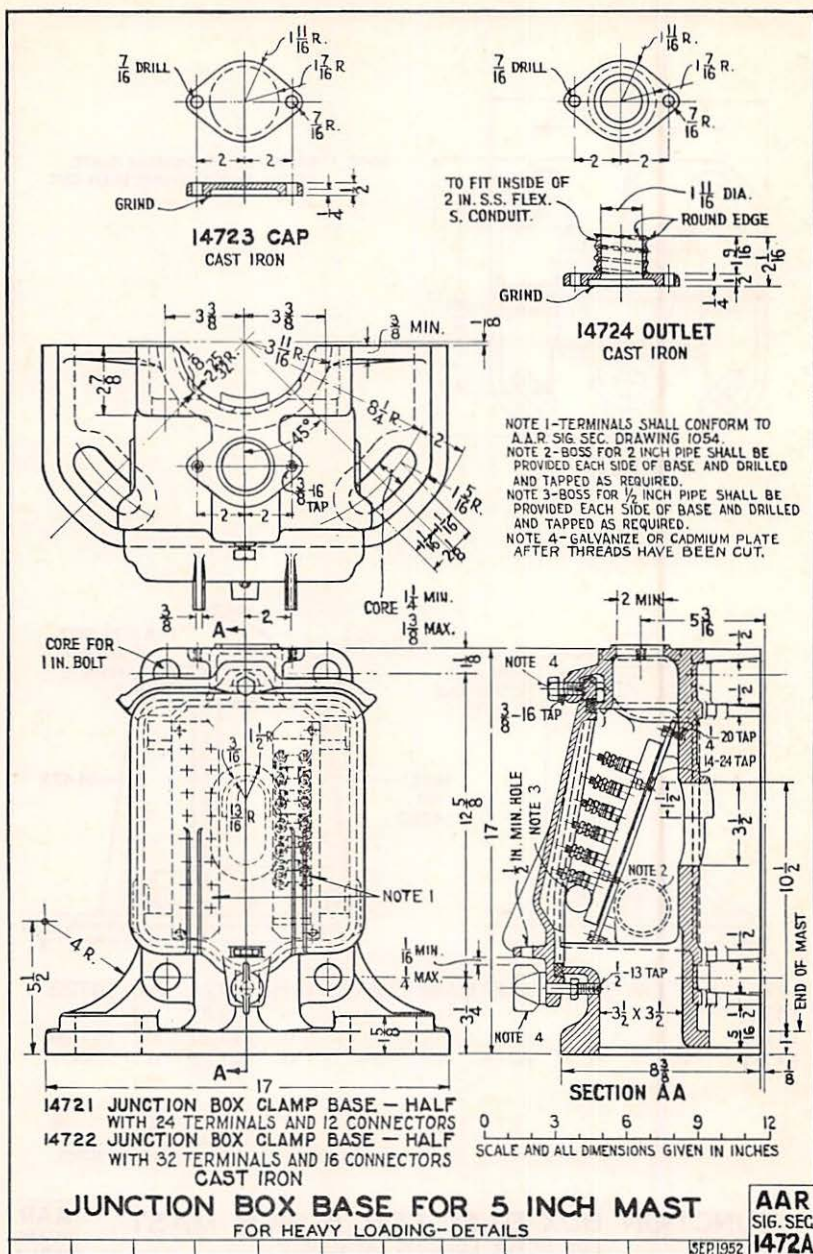
0 6 12 18
SCALE AND ALL DIMENSIONS GIVEN IN INCHES

JUNCTION BOX BASE FOR 5 INCH MAST
FOR HEAVY LOADING-ASSEMBLY

AAR
SIG. SEC.
1471 A

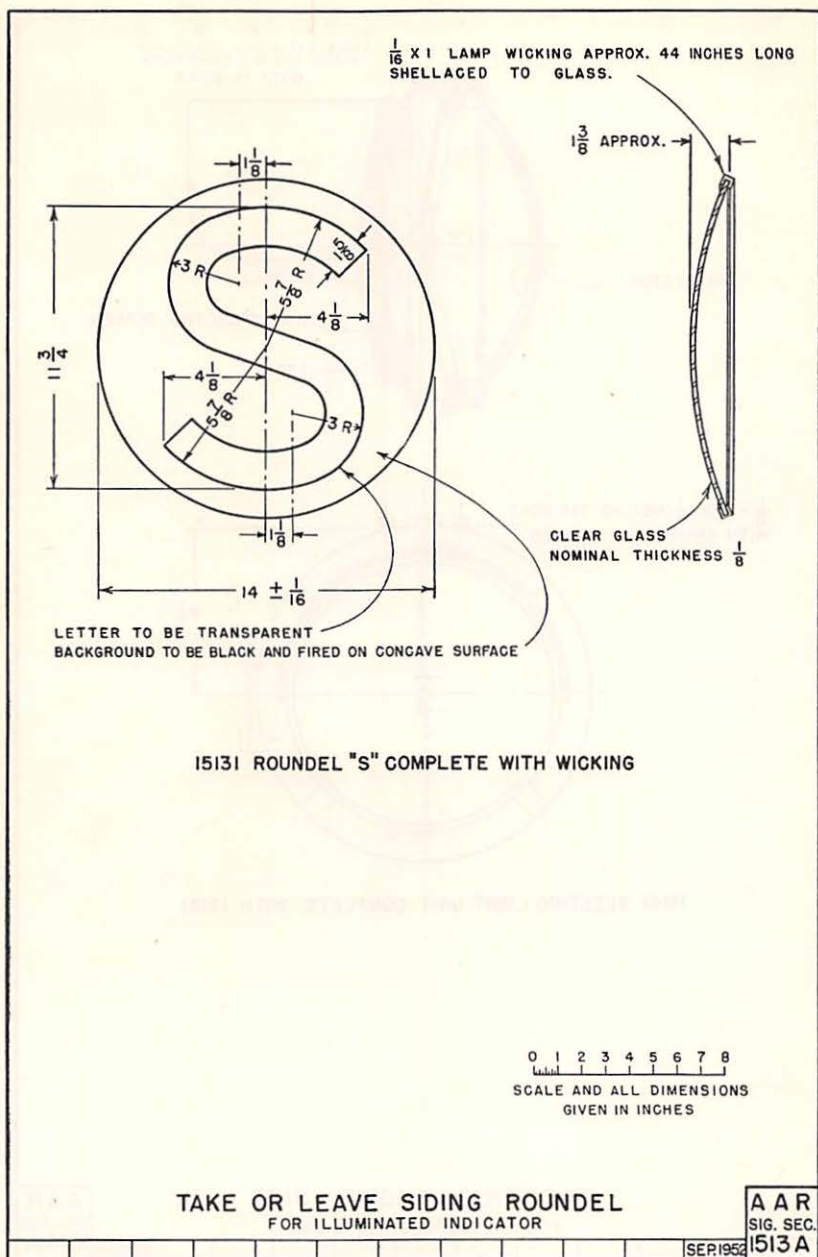
SEP 1952

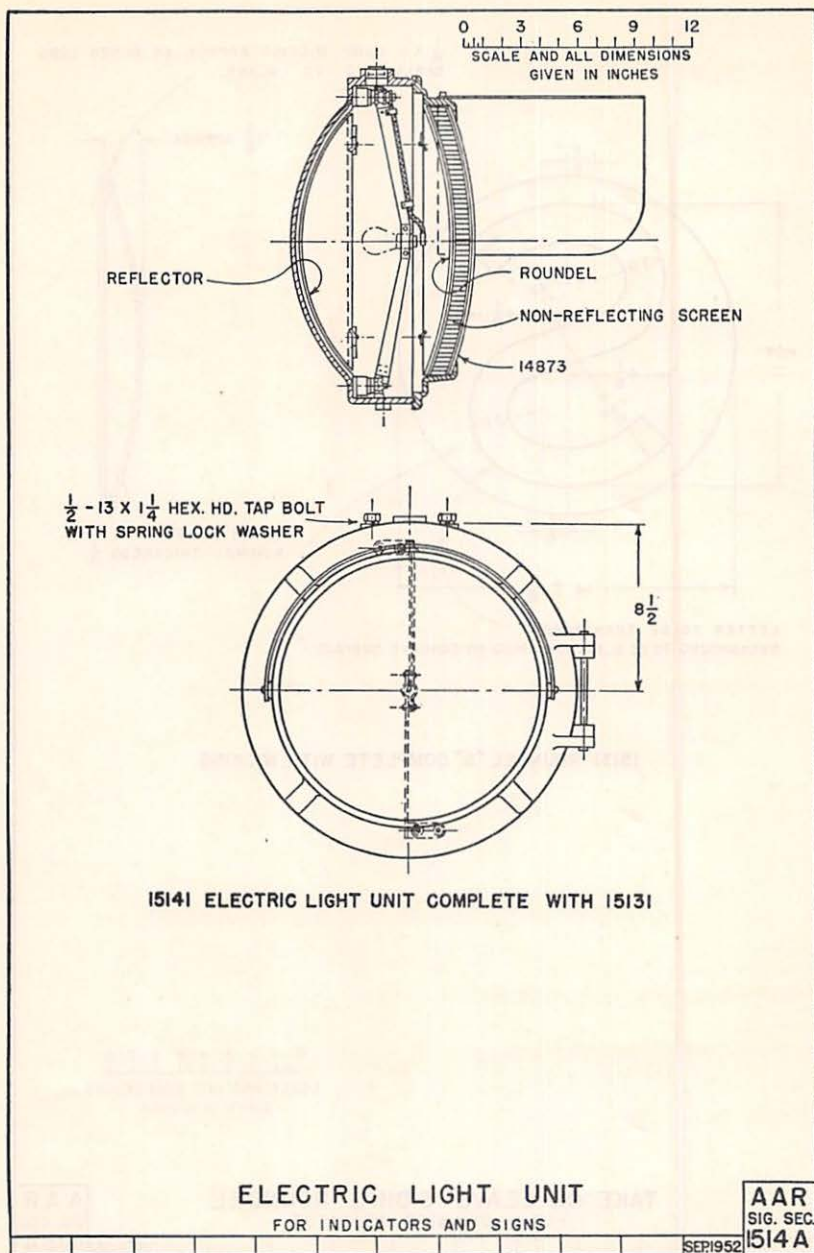
Bolts, nuts and threads shall be in accordance with Specifications for Bolts, Nuts and Threads,
Manual Part 17.



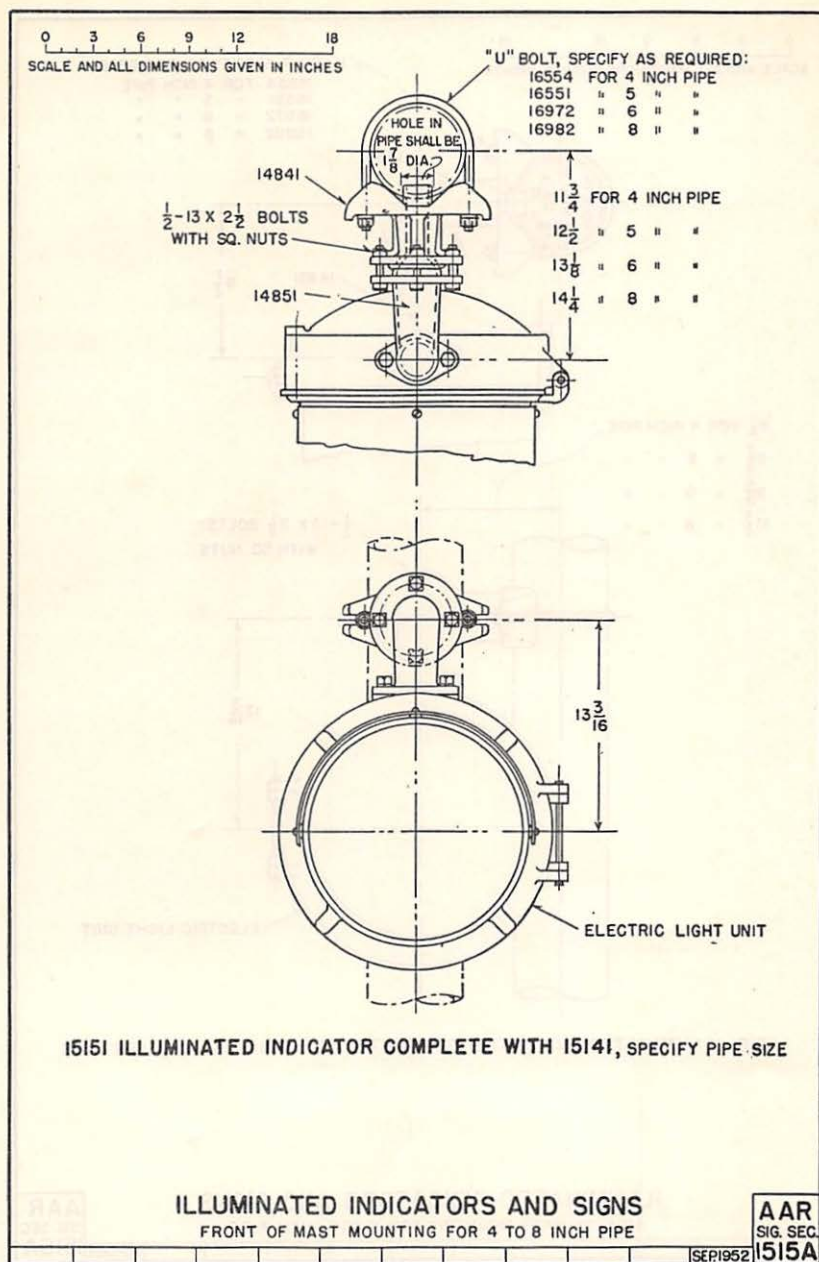
Cast iron shall be in accordance with Specification for Gray Iron Castings, Manual Part 88; Bolts, nuts and threads shall be in accordance with Specifications for Bolts, Nuts and Threads, Manual Part 17; Painting shall be in accordance with Specification 120, Manual Part 110.

Sept. 1952]

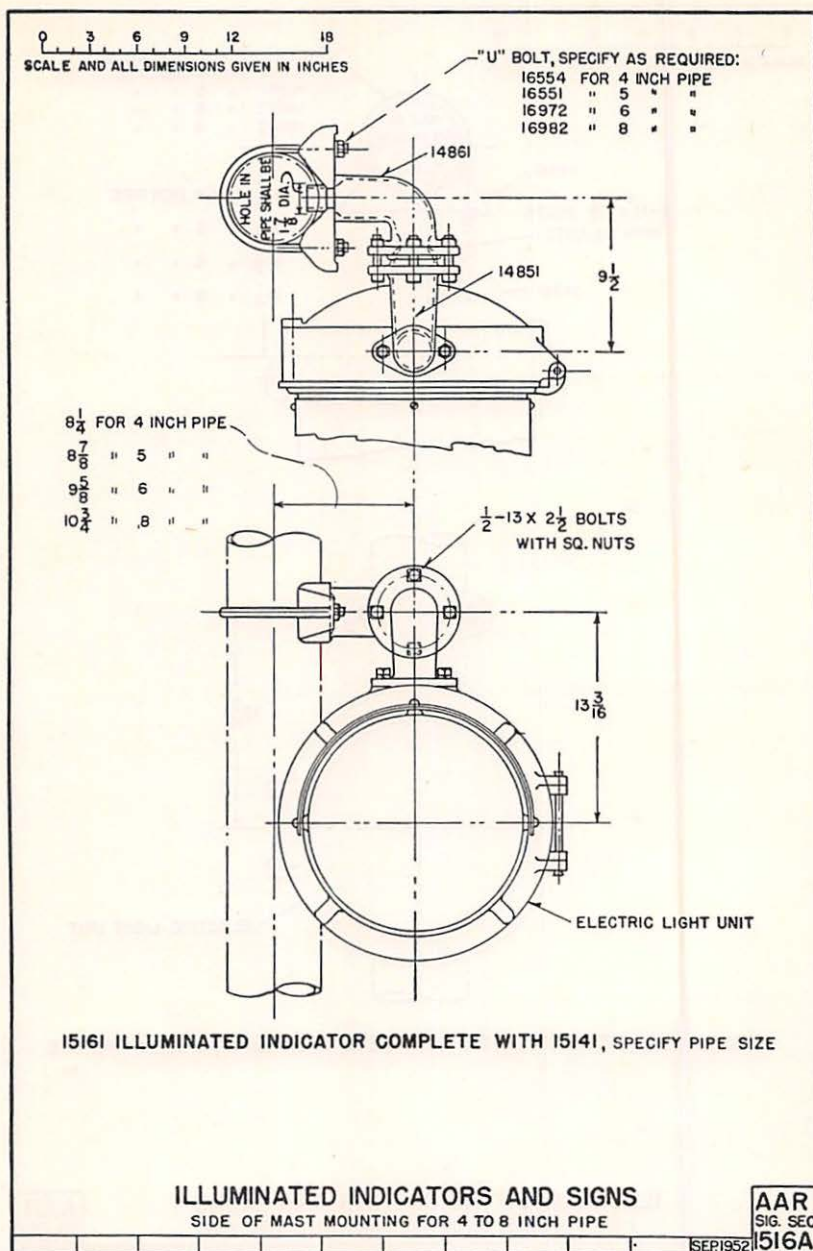




Unit shall be in accordance with Specification 231, Manual Part 237; Bolts, nuts and threads shall be in accordance with Specifications for Bolts, Nuts and Threads, Manual Part 17; Spring lock washers shall be of carbon steel (A.S.A. current Specification B27.1 is preferred, where practicable).



Indicator shall be in accordance with Specification 231, Manual Part 237; Bolts, nuts and threads shall be in accordance with Specifications for Bolts, Nuts and Threads, Manual Part 17.



Indicator shall be in accordance with Specification 231, Manual Part 237; Bolts, nuts and threads shall be in accordance with Specifications for Bolts, Nuts and Threads, Manual Part 17.

(Revision of A.A.R. Signal Section Specification 51-49)
A.A.R. SIGNAL SECTION SPECIFICATION 51-52.

INCANDESCENT ELECTRIC LAMPS

1. *Purpose.*

(a) This specification is for the purpose of providing for lamps generally required in railway signal lighting. It sets forth specific detail requirements representing modern signal practice recommended for new installations and for replacement on existing installations when general renewal or replacement becomes desirable.

(b) A list showing the activity rating of all lamps commonly used in signal practice is appended to this specification to encourage the elimination of lamps in the lower activity groups in the interest of standardization and simplification.

(c) This specification, so far as it refers exclusively to mechanical and physical characteristics, shall apply to all lamps purchased. The full provisions of this specification shall apply only to the lamps listed in the accompanying schedules of commercial ratings and tables of initial rating tolerances.

(d) The full provisions of this specification shall not apply to any inside frosted miniature lamps or to outside frosted, daylight or colored large or miniature lamps, or to lamps other than those with the usual clear or inside frosted bulbs, except that the wattage or ampere tolerances increased by 1 shall apply.

2. *Drawings and appendix.*

(a) Drawings and appendix referred to in the body of this specification form an essential part hereof.

(b) Manufacturer shall furnish with his tender, drawings forming an essential part thereof.

3. *Tender.*

(a) The tender shall be for a product meeting the requirements of this specification in its entirety.

4. *Purchaser's order requirements.*

(a) The following additional requirements will be shown on Purchaser's order:

1. Item number.
2. Supplier's ordering reference.
3. Inspection and tests as required.
4. Alternate requisites as required.

5. *Alternates.*

(a) The provisions contained in the alternate requisites section of this specification form a part hereof only when substituted by Purchaser's order for the provisions contained in this specification.

6. *Material and workmanship.*

(a) Material and workmanship shall be first-class in every respect.

7. *Definition and standards.*

(a) Large lamps designate broadly lamps regularly fitted with other than miniature bases. Miniature lamps designate broadly lamps designed for automotive, flashlight and similar types of service, and, in general, are equipped with bases smaller than those used in large lamps.

(b) Lamps shall conform to Drawings 1541, 1542 and 1543.

(c) Lamps shall conform to Appendix A.

(d) Electrical units referred to in this specification are the current International Units.

(e) Units of luminous intensity shall be the International Candle as maintained by the National Bureau of Standards, Washington, D. C.

(f) The basis of photometric measure for all lamps may be either the total flux expressed in lumens, or the equivalent mean spherical candlepower, which is the average candlepower of the lamp in all directions in space and equals the total luminous flux of the lamp divided by 12.57.

(g) The rating of lamps is expressed by volts together with either amperes, watts, candlepower or lumens.

(h) The life of the lamp is the rated average laboratory life in hours. In two filament lamps the burnout of either filament shall be considered as the end of life.

8. *Bulb and stem.*

(a) The material shall be lime or lead glass.

(b) Bulb shall be uniform in size and shape, clear, clean and free from flaws and blemishes detrimental to service.

9. *Base.*

(a) The material shall be good quality brass.

(b) Base shall be moisture-proof, the brass eyelet insulated from the base with glass, firmly and accurately fitted to the bulb with moisture-resisting cement.

10. *Filament.*

(a) The material shall be tungsten. *R-10-a.

* Alternate requisites section.

10. *Filament.*—Continued.

(b) Filament shall be free from imperfections detrimental to good service and shall be symmetrically disposed in the bulbs.

(c) The filament shall operate within an atmosphere of gas or within a vacuum. In either case the amount of air shall be as small as is obtainable with the best commercial practice.

11. *Leading-in wires.*

(a) The material shall be of good electrical conductivity and that portion imbedded in the glass shall have a coefficient of expansion as near that of the glass through which they pass as is practically possible.

(b) The wires shall be securely attached to the filament and to the base in such a manner that an electric circuit of good conductivity is permanently maintained.

12. *Identification.*

(a) Each lamp shall be plainly marked with rating and Manufacturer's name or trade-mark, on the bulb or base where space permits.

13. *Inspection.*

(a) The product furnished under this specification may be accepted upon Manufacturer's certificates of guarantee insuring that it is in accordance with the specification. If on arrival at destination the product is found not to meet the requirements of the specification it may be rejected and the Manufacturer, upon request, shall advise the Purchaser what disposition is to be made of the rejected product. Manufacturer shall pay all freight charges.

14. *Tests.*

(a) Tests may be made at point of production, or on samples submitted, and may also be made at destination.

(b) Manufacturer shall give the Purchaser sufficient notice of time when the material or product will be ready for testing.

(c) Manufacturer shall provide, at point of production, apparatus and labor for making required tests under supervision of the Purchaser.

(d) If tests are to be made at point of production, it shall be so stated on Purchaser's order. The Purchaser shall indicate which of the tests herein specified are to be made and what portion of the material or product shall be tested.

15. *Samples for test.*

(a) All lamps of any one type, size and voltage offered by the Manufacturer at any one time shall be known as a "lot."

15. *Samples for test.*—Continued.

(b) The number of lamps selected for physical and rating inspection and tests shall be not less than 5 per cent of the lot (minimum 10 large or 20 miniature), taken at random and proportionally from the individual packages of the lot.

(c) Test lamps used for rating test shall have been sufficiently burned (seasoned) to have reached stable values of watts and lumens (or candlepower) before the initial rating test is made.

16. *Acceptance requirements.*

(a) The finished lamps shall withstand successfully the performance tests and physical characteristics required by this specification and drawings referred to, which form an integral part of this specification.

(b) Physical defects.

1. Lamps shall not have minor defects that mar the appearance of the lamps or are otherwise incompatible with good workmanship or good service. A lot may be rejected without further test if 10 per cent plus 1 lamp (20 per cent plus 1 lamp when tested elsewhere than at the factory) or more of the test lamps have such defects.

2. Lamps shall not have major defects which would render lamps inoperative or which would cause them unquestionably to give poor service. A lot of large lamps may be rejected without further test if 1 per cent plus 1 lamp (2 per cent plus 2 lamps when tested elsewhere than at the factory) or more of the test lamps have such defects. A lot of miniature lamps may be rejected without further test if 1 per cent plus 2 lamps (2 per cent plus 3 lamps when tested elsewhere than at the factory) or more of the test lamps have such defects. Individual lamps having major physical defects may be rejected and eliminated from the lot.

(c) Manufacturer's declared efficiency.

1. The Manufacturer shall declare for each lot of lamps furnished under these specifications, the initial efficiency at which the lamps are to be appraised for compliance with rating and life requirements. The declared efficiency shall be not more than 2 per cent below the lumens-per-watt (large lamps), nor more than 4 per cent above the candles-per-watt (miniature lamps) value shown in Tables VII and VIII, Schedule of Commercial Ratings. For the purpose of maintaining the rated life given in the schedule, the efficiency of any size of lamp may be changed by notice from the Manufacturer, provided the preceding stipulation is complied with.

(d) Rejection for spread in rating.

1. Test lamps shall be operated at rated volts or amperes. A lot of lamps may be rejected if 20 per cent plus 2 lamps (30 per cent plus 2 lamps when tested elsewhere than

16. *Acceptance requirements.*—Continued.

at the factory) or more of the test lamps depart from the Manufacturer's declared initial rating by more than the tolerance specified in Tables V and VI, Initial Rating Tolerances. Individual test lamps may be rejected and eliminated from an accepted lot if they fall outside these tolerances by more than an additional 4 per cent for large and 8 per cent for miniature lamps.

(e) Life performance test.

1. Selection and quantities.

(a) Lamps for life performance test shall be selected from and be representative of the test lamps. They shall be selected in not less than the following ratios:

1. Large lamps: 4 from the first 1,000 and 1 from each 500 (or part) beyond 1,000 (minimum 5 lamps).

2. Miniature lamps: 8 from the first 1,000 and 2 from each 500 (or part) beyond 1,000 (minimum 10 lamps).

2. Life test voltages or currents.

(a) Lamps shall be operated on the test racks at design volts or at voltages corresponding either to the Manufacturer's declared efficiency (subject to the provisions of section 16-c-1), or to an efficiency or voltage mutually agreed upon. Operation at approximately the voltages indicated is sanctioned, provided proper life adjustments are made.

3. Position of burning.

(a) Lamps designed for a particular burning position shall be so tested. All other lamps shall be tested in the position in which they are most generally used in service.

4. Voltage regulation.

(a) Accurate recording meter records shall be obtained throughout the tests to show the variation of the circuit voltage. Variations of voltage shall not exceed one-half of 1 per cent above or below the test voltage on miniature lamps or one-fourth of 1 per cent on large lamps.

5. Rejection.

(a) Any lot of lamps, provided that such lot is represented on test by at least the minimum required number of lamps in accordance with section 16-e-1-a may be rejected if the average hours' life of the test lamps when computed to the Manufacturer's declared initial efficiency rating falls below the life value specified in

16. *Acceptance requirements.*—Continued.

Tables VII and VIII, Schedules of Commercial Ratings, by more than the life tolerance specified in the following tables* for the number of test lamps averaged.

TABLE I
Life Tolerances (Large Lamps)

Number of lamps averaged	Allowable per cent variation	Number of lamps averaged	Allowable per cent variation	Number of lamps averaged	Allowable per cent variation
250 and above	5	24-20	12	9	19
249 to 100	6	19-18	13	8	20
99 to 55	7	17-16	14	7	21
54 to 45	8	15-14	15	6	23
44 to 35	9	13-12	16	5	25
34 to 30	10	11	17		
29 to 25	11	10	18		

TABLE II
Life Tolerances (Miniature Lamps)

Number of lamps averaged	Allowable per cent variation from rated life
100 and above	15
40-99	16
20-39	17
10-19	18

The life tolerance for any type of lamp is determined by multiplying the allowable per cent variation in Table II by the "multiplying factor" for the particular lamp, as given in Tables V and VI, Initial Rating Tolerances.

(f) Determination of efficiency (lumens or candlepower) maintenance.

1. Large.

(a) Test lamps shall be measured at test volts (or amperes) for lumens-per-watt (or lumens) after an interval equivalent to 70 per cent of the rated life of the lamps. (If lamps are tested at Manufacturer's declared initial lumens-per-watt, the interval will be exactly 70 per cent of the rated life; if tested at some other agreed upon lumens-per-watt or at labeled volts (or amperes) an equivalent interval shall be computed for each lamp.)

* On account of the natural and inherent variations in individual lamp performance, the average test results of a small number of test lamps cannot be depended upon to indicate exactly the average for the larger quantity from which the test lamps were taken. The allowable variations shown in Tables I-VI are devised in accordance with the observed accuracy of lamp-testing methods and the observed variations in lamp performance.

16. *Acceptance requirements.*—Continued.

2. Miniature.

(a) Test lamps shall be measured for spherical candlepower at their design volts, both initially and at the expiration of four-fifths of the rated life. The measure of candlepower maintenance for an individual lamp shall be its spherical candlepower at four-fifths of the rated life, expressed as a percentage of its initial spherical candlepower.

3. Rejection.

(a) Large lamps for multiple circuits. Any lot of lamps may be rejected provided such lot is represented on test by the minimum required number of lamps in accordance with section 16-e-1-a-1 if the average lumens-per-watt at the 70 per cent interval determined in accordance with section 16-f-1-a falls below the value specified in Table VIII, Schedule of Commercial Ratings, by more than the tolerance specified in Table III. (If lamps are tested at other than the Manufacturer's declared initial lumens-per-watt, the lumens-per-watt at the 70 per cent interval shall be corrected by multiplying by the ratio of declared lumens-per-watt to initial test lumens-per-watt.)

(b) Miniature lamps, when tested in accordance with the foregoing test specifications. Any lot of lamps may be rejected, provided such lot is represented on life performance test by the minimum required number of lamps in accordance with section 16-e-1-a-2, and provided the per cent spherical candlepower at four-fifths rated life, as derived in accordance with section 16-f-2-a, falls below the per cent specified in Table VII, Schedule of Commercial Ratings, by more than the tolerance specified in Table IV.

TABLE III
Maintenance Tolerances (Large Lamps)

Number of lamps tested	Allowable per cent variation
100 and above	1
99-25	2
24-10	3
9-5	4

16. *Acceptance requirements.*—Continued.TABLE IV
Candlepower Maintenance Tolerances (Miniature Lamps)

Number of lamps tested	Allowable variation in candlepower at four-fifths rated life in per cent of average initial candlepower
100 and above	2
40-99	4
20-39	6
10-19	8

TABLE V
Initial Rating Tolerances (Miniature Lamps)

Lamp designation Trade No.	Base	Rated spherical candlepower	Circuit volts	Bulb	Initial rating tolerances at design volts			
					Variation in candles per watt, plus or minus	Variation in spherical candle- power, plus or minus	Variation in amperes, plus or minus	Multiplying factor for basic life tolerances
					Per cent	Per cent	Per cent	
67	SC	3	12-16	G-6	12	15	8	2.0
68	DC	3	12-16	G-6	12	15	8	2.0
87	SC	15	6-8	S-8	7	9	5	1.0
89	SC	6	12-16	G-6	12	15	8	1.5
1141	SC	21	12-16	S-8	9	10	6	1.0
63K	S. Can.	*3	6-8	G-6	6	8	5	1.5
67K	S. Can.	*3	12-16	G-6	12	15	8	2.0

* The candlepower is nominal.

TABLE VI
Initial Rating Tolerances (Large Lamps)

Watts	Volts	Bulb	Base	Initial rating tolerances at rated voltage	
				Lumens-per-watt above or below declared rating	Total watts above or below rating
9	12	G-16½	2 pin sleeve	12	7
11	11	S-11	Bayonet Candel.	12	7
18	10	A-15	2 or 3 pin sleeve	10	7

16 Acceptance requirements.—Continued.

TABLE VII

Schedule of Commercial Ratings (Miniature Lamps)

Trade No.	Base	Circuit, volts	Design, amperes	Rated spherical candle-power	Bulb	Maximum over-all length, inches	Light center length, inches	Design, volts	Candle-power maintenance at 4/5 life*, % of initial	Initial candles (spherical), per watt	Rated average laboratory life, hours
67	Bayonet Candel. SC	12-16	0.36	3	C-6	$1\frac{7}{16}$	$1\frac{3}{16}$	13.00	84	0.64	1,000
68	Bayonet Candel. DC	12-16	0.36	3	C-6	$1\frac{7}{16}$	$1\frac{3}{16}$	13.00	84	0.64	1,000
87	Bayonet Candel. SC	6-8	1.91	15	S-8	2	$1\frac{1}{8}$	6.75	90	1.16	300
89	Bayonet Candel. SC	12-16	0.58	6	G-6	$1\frac{7}{16}$	$\frac{3}{4}$	13.00	82	0.80	750
1141	Bayonet Candel. SC	12-16	1.36	21	S-8	2	$1\frac{1}{4}$	12.80	82	1.20	500
63K	S. Can.	6-8	0.63	†3	G-6	$1\frac{3}{8}$	$1\frac{5}{16}$	7.00	91	0.74	1,000
67K	S. Can.	12-16	0.36	†3	G-6	$1\frac{3}{8}$	$1\frac{5}{16}$	13.00	83	0.71	1,000

* These maintenance values apply to base horizontal burning.

† The candlepower is nominal.

16. Acceptance requirements.—Continued.

TABLE VIII
Schedule of Commercial Ratings (Large Lamps)

Watts	Volts	Bulb	Base	Initial lumens	Initial lumens-per-watt	Rated average life (hours)†	Filament	Light center length, inches	Maximum over-all length, inches	Position of burning
9	12	G-16½	2 pin sleeve	95	10.5	1,500	C-2R	*1.91	3	Any
11	11	S-11	Bayonet Candel.	104	9.5	2,500	C-2V	1¼	2⅜	Any
18	10	A-15	2 or 3 pin sleeve	207	11.5	1,500	C-2V	2⅛ ₃₂ or 2⅜ ₁₆	3¾	Any

* Measured to top of filament.

† Life under specified test conditions.

17. *Packing.*

(a) Product shall be so assembled or packed as to permit convenient handling and to protect against loss or damage during shipment.

18. *Marking.*

(a) Purchaser's order, requisition and package number, name of Consignor, and name and address of Consignee, shall be plainly marked on outside of packages and on tags attached to loose pieces.

(b) Detail list of loose pieces, packages and their contents shall be furnished for each shipment. Where carload shipments are made, routing and car identification shall be shown.

Alternate requisites.

R-10-a.

The material shall be.....

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Specification 51-49—Incandescent Electric Lamps, Manual Part 91.

APPENDIX A

SIMPLIFICATION AND STANDARDIZATION OF INCANDESCENT
ELECTRIC LAMPS FOR RAILROAD SIGNAL PURPOSES

This list has been compiled to encourage the use of lamps in the more active group ratings, and the elimination as far as practicable of those in the lower activity groups.

ACTIVITY GROUP BASED ON PERIOD 1949-1952, SPECIAL TYPES.

	No. of items
A 10,000 or more lamps sold per year	11
B 1,000 to 10,000 " " " "	35
C 100 to 1,000 " " " "	28
D 1 to 100 " " " "	8
X No " " " "	0

82 Total

Note.—Lamps in the COMMERCIAL group not included in above total.

Symbols, Abbreviations and Notes Pertaining to Activity Group Tables

TYPES:

Special—Lamps designed for signal use

Commercial—Lamps designed primarily for services other than signaling

SOURCE:

W—Westinghouse Electric Corp., Lamp Division

G—General Electric Co., Lamp Department

GRS—General Railway Signal Co.

US&S—Union Switch & Signal Div. of Westinghouse Air Brake Co.

WE—Western Electric Co.

PC. No.—Piece Number

Dwg. No.—Drawing Number

ELECTRICAL:

A—Amperes

W—Watts

CP—Spherical Candlepower

BULB:

Shape—Drawing 1541

Color—Clear unless otherwise noted

Class—Type C (Gas filled unless otherwise noted)

*—Type B (Vacuum)

BASE (Drawing 1542):

B.MIN—Bayonet miniature, single contact

SC—Bayonet candelabra, single contact

DC—Bayonet candelabra, double contact

BASE (Drawing 1542)—Continued:

- S.MIN—Screw miniature
- S.CAN—Screw candelabra
- S.MED—Screw medium
- 2-PS—Rebased with 2 pin sleeve (US&S)
- 3-PS—Rebased with 3 pin sleeve (GRS)
- 1825—Used with 2 and 3 pin sleeve
- SL.1—Slide telephone switchboard (902, W-G-GRS)
- SL.2—Slide telephone switchboard (WE)
- SL.3—Slide telephone switchboard (905, G-US&S)

FILAMENT:

- MF—Major filament
- SF—Secondary filament
- Shape—Drawing 1543
- INV.—Inverted
- LCL—Light center length in inches
- Tolerance—Plus-minus dimensions in inches allowed on LCL and AA (axial alignment). Where two dimensions are shown the first applies to LCL and the second to AA. Where no tolerance is shown, Manufacturer's standard to apply
- Material—Tungsten unless otherwise noted

LIFE HOURS:

Manufacturer's laboratory rated average burning hours of a group of lamps tested under specified test conditions

MANUFACTURERS' DESIGNATION:

- RLS—Railroad light signal, visible day and night indication
- RS—Railroad signal, visible night indication only
- Manufacturers' ordering abbreviation or number shown for commercial type lamps

RAILROAD USE:

- SEM—Semaphore signal
- CLT—Color light signal
- PLT—Position light signal
- CPLT—Color position light signal
- SLT—Searchlight signal
- TO—Train order signal
- XNG—Highway crossing signal
- IND—Indicator
- LL—Lever light
- CTI—Chart track indicator (includes C.T.C.-NX-UR)
- SL—Switch lamp
- CGA—Crossing gate arm

Note.—Tables are revised triennially and lamps shown in the X group removed. Current X group lamps have been delisted by the Manufacturers and discontinued.

ACTIVITY GROUP TABLE INCANDESCENT ELECTRIC LAMPS FOR RAILROAD SIGNAL PURPOSES—SPECIAL TYPES

Activity group	Item No.	Mfr. desig.	Source			Amps. Watts CP	Volts	Bulb	Base	Filament				Life hours	Railroad use	Principal railroads using
			GRS Dwg. No.	W-G	US&S PC.No.					Shape		LCL	Tolerance			
										MF	SF					
C	1	RLS	47438-9GR5	W-G		10W	8	A-15	3-PS	A-Bulb						GN
B	2	RLS		W-G	144539	10W	8	A-15	2-PS	C-2R		27/32	1/64	1,000	CLT	Clin-L&N-MKT
D	3	RLS		W-G	189826	10W 13.5W	8	A-15	2-PS	C-2V		27/32	1/64	1,500	CLT-XNG	WM
C	4	RLS	47438-9GR4	W-G		18W	8	A-15	3-PS	C-2R	C-2V-INV	27/32	1/64	1,500	CLT	B&O-D&RGW-GN-MP-NYC-NP-T&P
B	5	RLS		W-G	144541	18W	8	A-15	2-PS	C-2V		27/32	1/64	1,500	CLT	MKT-UP
C	6	RLS	47438-6GR2	W-G		18W	8	A-15	3-PS	2C-2V		27/32	1/64	1,500	CLT	FEC-GM&O-PRR
C	7	RLS		W-G	184972	18W 13.5W	8	A-15	2-PS	C-2V	C-2V-INV	27/32	1/64	1,500	CLT	CMS&P&C-CRI&P-L&N-NC&StL-SP-UP
B	8	RLS	47438-22GR1	W-G		18W 13.5W	8	A-15	3-PS	C-2V	C-2V-INV	27/32	1/64	1,500	CLT	C&N&W-CRI&P-GM&O-NC&StL-T&P
B	9	RLS	47438-23GR1	W-G		40W	8	A-15	3-PS	C-2V		27/32	1/64	3,000	CLT-SEM	NYNH&H
B	10	RLS		W-G	135247	10W	10	A-15	2-PS	C-2V		27/32	1/64	1,500	CLT	CGW-CRI&P-SAL-T&NO-UP
D	11	RLS	47438-9GR2	W-G		10W	10	A-15	3-PS	C-2R		27/32	1/64	1,500	CLT	C&P&M&O-DM&IR-FEC
B	12	RLS	47438-0GR3	W-G		18W	10	A-15	3-PS	2C-2V		27/32	1/64	1,500	CLT*	KCS-L&N-MP-NYC&StL-N&W-T&P-Wab
B	13	RLS	47438-20GR1	W-G		18W 13.5W	10	A-15	3-PS	C-2V	CC-6	27/32	1/64	1,500	CLT	B&M-CGW-CRI&P-GM&O-NC&StL-NYC-Sou
B	14	RLS	47438-9GR6	W-G		18W	10	A-15	3-PS	C-2R		27/32	1/64	1,500	CLT	C&N&W-D&RGW-FEC-GM&O-NYC-Sou-T&P
A	15	RLS		W-G	142944	18W	10	A-15	2-PS	C-2V		27/32	1/64	1,500	CLT-XNG	CNJ-CRI&P-DL&W-Erie-NYC-NYC&StL-NYNH&H-N&W-UP-Wab
A	16	RLS		W-G	214227	18W 13.5W	10	A-15	2-PS	C-2V	CC-6	27/32	1/64	1,500	CLT-XNG	AT&SF-ACL-C&O-CMS&P&P-CRI&P-IC-L&N-NYNH&H-PRR-SAL-UP
B	17	RLS		W-G	144543	30W	10	A-15	2-PS	C-2V		27/32	1/64	1,500	CLT-XNG	A&S-CRI&P-DL&W-Erie-NYC&StL-PRR-UP
B	18	RLS		W-G	189825	30W 16W	10	A-15	2-PS	C-2V	CC-6	27/32	1/64	1,500	CLT-XNG	AT&SF-C&O-CRI&P-Erie-NC&StL-PRR-StLSF-SAL
B	19	RLS		W-G	144545	40W	10	A-15	2-PS	C-2V		27/32	1/64	1,500	CLT	CNJ-L&N-NC&StL-NYNH&H-N&W-Rdg
B	20	RLS	47438-15GR1	W-G		40W	10	A-15	3-PS	C-2V		27/32	1/64	1,500	CLT	B&O-CRI&P-NYC-NYNH&H
D	21	RLS	47438-0GR1	W-G		40W	10	A-15	3-PS	2C-2V		27/32	1/64	1,500	CLT	D&RGW-P&WV-StLSF-T&P
B	22	RLS	47438-21GR1	W-G		40W 13.5W	10	A-15	3-PS	C-2V	C-2V-INV	27/32	1/64	1,500	CLT	GSF-NC&StL-Rdg
C	23	RLS		W-G	120620	36W	30	A-15	2-PS	2C-2V		27/32	1/64	1,500	CLT-XNG	AT&SF-C&IM-N&W
D	24	RLS	47438-0GR4	W-G		36W	30	A-15	3-PS	2C-2V		27/32	1/64	1,500	CLT	C&IM
C	25	RLS	47438-12GR1	W-G		30W	120	A-15*	3-PS	C-5		27/32	1/64	1,500	CLT	B&O-B&M-CRI&P-GN-MP
C	26	RLS		W-G	144551	30W	120	A-15*	2-PS	C-5		27/32	1/64	1,500	CLT	B&M-CP-CMS&P&P-Li-WofA
A	27	RLS		W-G	215005	9W	12	CT-7	SC	CT-Bulb		1 1/4	1/64	1,500	PLT	B&O-NYC&StL-PRR-Rdg-Wab
C	28	RS	43198-7	W-G		0.20A	14	G-6*	S.Min	G-Bulb		1 3/8		1,000	IND-LL-CTI	AT&SF-B&O-Erie-GTW-LV
B	29	RS		W-G	75679	1.25W	12	G-8*	S. Can	C-2V		1		1,000	IND-LL-CTI	ACL-B&O-C&O-Erie-NYC-NYNH&H-RF&P
C	30	RLS		W-G	221241	29W 16.5W	6	G-16 1/2	xSC	C-2R	CC-6	1 5/8	1/64	3,000	CLT	AT&SF-CMS&P&P
C	31	RLS		W-G		40W	8	G-16 1/2	S. Med	C-2V		1 3/4		1,000	SEM	NYNH&H

x Special.

† LCL measured to top of filament.

ACTIVITY GROUP TABLE INCANDESCENT ELECTRIC LAMPS FOR RAILROAD SIGNAL PURPOSES—SPECIAL TYPES

Activity group	Item No.	Mfr. desg.	Source			Amps. Watts CP	Volts	Bulb.	Base	Filament				Life hours	Railroad use	Principal railroads using
			GRS Dwg. No.	W-G	US&S PC. No.					Shape		LCL	Tolerance			
										MF	SF					
A	32	RLS	34866-69	W-G	220601	40W	10	G-16 1/2	SC	G-Bulb (Contd.)	CC-6 C-2R	1 1/4 †1.91	1 1/4 1/4	1,000	CLT-XNG	L&H-PRR-Rdg-StLSF-SAL-SP B&O-C&O-CMStP&P-LV-L&N-NYC-NYC&StL-N&W-PRR-Wab B&M-EJ&E-DM&IR-KCT C&NW-CB&Q-FEC-NP A&S-C&WI
C	33	RLS	47438-14GR1	W-G	152591	9W	12	G-16 1/2	2-PS					1,500	PLT	
B	34	RLS	34866-45	W-G		25W	120	G-16 1/2 *	SC	CC-11 C-5 2C-2V S-Bulb	C-2R	1 1/4 1 1/4 2 1/8	1/4 1/4 1/4	1,000	CLT-SLT	DT&I-Erie-StLSF-PRR CB&Q AT&SF-B&O-B&M-CGW-CMStP&P-CRI&P-KCS-L&N-NYC-SAL-Sou-WM AT&SF-ACL-CB&Q-CMSP&P-CRI&P-IC-L&N-MKT-NYC-UP CMSP&P-CRI&P-T&NO SP CN-CRI&P-GM&O-L&N-NYC-NP-PRR-T&NO-T&P-WP-UP NYC B&M-D&H-DM&IR-FEC-NYC-PRR-StLSF-T&NO-T&P-Wab NP AT&SF-ACL-B&O-C&O-CB&Q-CGW-CMSP&P-CRI&P-EJ&E-Erie-LV-L&N-MRy&TCo-NP-SAL-UP MKT CGW-CMSP&P-NYC-N&W-Wab-WofA AT&SF-B&M-IC-LV-MP-PRR-Sou AT&SF-IC-SP DM&IR AT&SF-ACL-CMSP&P-CRI&P ACL-CP-CMSP&P-CRI&P-DM&IR-PRR-Rdg C&NW-L&N-T&P CLT-SGW-IC-MKT-NYC&StL-SP AT&SF-C&NW-CMSP&P-Erie-PRR-Rdg-SAL-SP-T&P D&RGW-DM&IR-GM&O-T&P C&NW-CRI&P-MKT-SP AT&SF-CMSP&P-D&RGW-NC&StL-StLSF-SOU T&P
C	35	RLS	34866-46	W-G	135893	25W	120	G-16 1/2 *	SC					1,000	CLT	
B	36	RLS		W-G	112968	36W	30	G-18 1/2	S. Med					1,500	CLT	
B	37	RS	34866-65	W-G	188498	0.15A	2.5	S-8 *	SC	C-2R	C-2R	1 1/4 1 1/4 1 1/4	1/4 1/4 1/4	1,000	SEM-SLT	SEM SL SEM-CLT-SLT
C	38	RS		W-G		0.15A	2.7	S-8 *	SC					1,000	SL	
B	39	RS	34866-56	W-G	172274	0.12A	3.5	S-8 *	SC					1,000	SEM-CLT-SLT	
B	40	RS	34866-2	W-G	120799	0.3A	3.5	S-8 *	SC	C-2R	C-2R	1 1/4 1 1/4	1/4 1/4	1,000	SEM-SLT-CGA	SEM SEM SEM
B	41	RS	34866-3	W-G	120800	0.25A	8	S-8 *	SC					1,000	SEM	
C	42	RS		W-G	208573	0.25A	10	S-8 *	DC	C-2R	C-2R	1 1/4 1 1/4	1/4 1/4	1,000	SEM	SEM
B	43	RS	34866-4	W-G	120801	0.25A	10	S-8 *	SC					1,000	SEM	
C	44	RS		W-G		0.12A	12	S-8 *	SC	C-2V	C-2R	1 1/4 1 1/4	1/4 1/4	1,000	SEM	SEM
B	45	RS	34866-5	W-G	120802	0.25A	12	S-8 *	SC					1,000	SEM-CLT	
C	46	RS	34866-73	W-G		0.12A	13.5	S-8 *	SC	C-2V	C-2R	1 1/4 1 1/4	1/4 1/4	1,000	SEM	SEM
A	47	RS	34866-6	W-G	120803	0.25A	13.5	S-8 *	SC					1,000	SEM-XNG	
C	48	RS		W-G	124019	0.25A	13.5	S-8 *	DC	C-2R	C-7A	1 1/4 1 1/4	1/4 1/4	1,000	SEM	SEM
C	49	RS		W-G	176725	10W	120	S-8 *	SC					1,500	SEM-XNG	
C	50		48389			2CP	125	S-8 *	S. Min	Carbon multi-loop	multi-loop	anchored to bulb	anchored to bulb		LL	AT&SF-B&M-IC-LV-MP-PRR-Sou AT&SF-IC-SP
D	51		54647-1			2CP	125	S-8 *	SC						LL	
C	52	RLS	34866-55	W-G		5W	8	S-11	SC	C-2R	C-2V	1 1/4 1 1/4	1/4 1/4	1,000	CLT-XNG	CLT-SLT-XNG
C	53	RLS		W-G	168741	5W	8	S-11	SC					1,000	CLT-SLT-XNG	
B	54	RLS	34866-58	W-G	192057	5W †3.5W	8	S-11	SC	C-2V	C-12	1 1/4 1 1/4	1/4 1/4	1,000	CLT-SLT-XNG	CLT-SLT-XNG
D	55	RLS	34866-43	W-G		10W	8	S-11	SC					1,000	CLT-SLT-XNG	
B	56	RLS		W-G	142967	10W	8	S-11	SC	C-2V	C-12	1 1/4 1 1/4	1/4 1/4	1,000	CLT-SLT-XNG	CLT-SLT-XNG
A	57	RLS	34866-37	W-G	159440	13W †3.5W	8	S-11	SC					1,000	CLT-SLT-XNG	
D	58	RLS	34866-44	W-G		18W	8	S-11	SC	C-2R	C-2V	1 1/4 1 1/4	1/4 1/4	1,000	CLT-XNG	CLT-SLT-XNG
B	59	RLS		W-G	177731	18W	8	S-11	SC					1,000	CLT-SLT-XNG	
B	60	RLS	34866-78	W-G	199177	18W †3.5W	8	S-11	SC	C-2V	C-12	1 1/4 1 1/4	1/4 1/4	1,000	CLT-XNG	CLT-XNG
C	61	RLS	34866-34	W-G		15.3W	9	S-11	SC					C-2R		

† LCL measured to top of filament.

ACTIVITY GROUP TABLE INCANDESCENT ELECTRIC LAMPS FOR RAILROAD SIGNAL PURPOSES—SPECIAL TYPES

Activity group	Item No.	Mfr. desg.	Source			Amps. Watts CP	Volts	Bulb	Base	Filament				Life hours	Railroad use	Principal railroads using
			GRS Dwg. No.	W-G	US&S PC. No.					Shape		LCL	Tolerance			
										MF	SF					
B	62	RLS		W-G	148970	5W	10	S-11	SC	S-Bulb C-2V	(Contd.)	1 1/4	1/64	1,000	CLT-SLT-XNG	AT&SF-ACL-CP-C&O-CRI&P-Erie-IC-MKT-StLSF-SP-Sou
B	63	RLS	34866-38	W-G		5W	10	S-11	SC	C-2R		1 1/4	1/64	1,000	CLT-SLT	B&M-CP-C&NW-CB&Q-FEC-L&N-MP-NYC-StLSF-Sou
B	64	RLS	34866-70	W-G	221513	5W †3.5W	10	S-11	SC	C-2V	C-12	1 1/4	1/64	1,000	CLT-SLT	C&NW-CGW-CRI&P-DM&IR-KCS-L&N-StLSF-Wab-WP
B	65	RLS		W-G	146930	10W	10	S-11	SC	C-2V		1 1/4	1/64	1,000	CLT-SLT-XNG	ACL-C&O-C&NW-CMStP&P-CRI&P-Erie-L&N-Sou-WofA-WP
B	66	RLS	34866-33	W-G		10W	10	S-11	SC	C-2R		1 1/4	1/64	1,000	CLT-SLT-XNG	B&O-B&M-CN-C&NW-KCS-MP-NYC-NP-Sou-T&P
A	67	RLS	34866-60	W-G	182814	13W †3.5W	10	S-11	SC	C-2V	C-12	1 1/4	1/64	1,000	CLT-SLT-XNG	CB&Q-CRI&P-CI&L-D&H-D&M-EJ&F-Erie-GTW-GM&O-IC-KCS-LV-L&N-NYC&StL-NYNH&H-PRR-Sou-StLSF-UP-Wab
A	68	RLS		W-G	151138	18W	10	S-11	SC	C-2V		1 1/4	1/64	1,000	CLT-XNG-CGA	AT&SF-ACL-B&M-C&O-C&NW-CMStP&P-CRI&P-Erie-GTW-GM&O-NC&StL-NYC&StL-N&W-PRR-Sou-UP
A	69	RLS	34866-29	W-G		18W	10	S-11	SC	C-2R		1 1/4	1/64	1,000	CLT-SLT-XNG	B&O-CP-C&O-C&NW-CRI&P-D&RGW-GM&O-KCS-LV-L&N-MP-NYC-NP-Rdg-Sou
B	70	RLS		W-G	175067	25W	10	S-11	SC	C-2V		1 1/4	1/64	1,000	CLT-SLT-XNG	ACL-CMStP&P-CRI&P-IC-NYNH&H-PRR-Rdg-UP-Wab
B	71	RLS	34866-47	W-G		25W	10	S-11	SC	C-2R		1 1/4	1/64	1,000	CLT-SLT-XNG	C&NW-D&H-GM&O-MP-NYNH&H-StLSF
A	72	RLS	34866-59	W-G	145877	11W	11	S-11	SC	C-2V		1 1/4	1/64	2,500	CLT-SLT-XNG-CGA	AT&SF-B&M-CP-DL&W-L&N-NC&StL-N&W-PRR-Rdg-StLSF-UP-WP
C	73	RLS		W-G	134832	11W	11	S-11	DC	C-2V		1 1/4	1/64	2,500	SLT	SP
A	74	RLS	34866-52	W-G	191859	14.4W †3.5W	11.3	S-11	SC	C-2V	C-12	1 1/4	1/64	1,000	CLT-SLT-XNG	CB&Q-NP
B	75	RLS	34866-25	W-G	135722	17W	13.5	S-11	SC	C-2V		1 1/4	1/64	2,000	CLT-CPLT-SLT-XNG	B&O-CI&L-GM&O-LV-NYC-NYC&StL-PRR-Wab
B	76	RS	50371-12	W-G	74066	2.5W	12	S-14	* S. Med	S-1		2 1/2	5/64	1,500	SEM	AT&SF-DM&IR-IGN-KCS-LV-MP-NYC-PRR-Sou
D	77	RS	50371	W		5W	12	S-14	* S. Med	S-1		2 1/2	5/64	1,500	SEM	KCS
B	78	RS	50371-14	W-G	144171	5W	14	S-14	* S. Med	S-1		2 1/2	5/64	1,500	SEM	CP-DM&IR-RF&P
C	79	RS		W-G		5W	32	S-14	* S. Med	S-1		2 1/2	5/64	1,500	SEM	AT&SF
C	80			W	209679	0.17A	14	T-3	* B. Min	C-2V		5/8	Red coating	250	IND-CTI	CNJ-StLSF
C	81			W	209711	0.17A	14	T-3	* B. Min	C-2V		5/8		250	IND-CTI	CNJ-StLSF
C	82	RS		W-G		0.15A	8	T-4	* S. Can	S-3		1		150	IND-CTI	C&NW

† LCL measured to top of filament.

ACTIVITY GROUP TABLE INCANDESCENT ELECTRIC LAMPS FOR RAILROAD SIGNAL PURPOSES—COMMERCIAL TYPES

Item No.	Mfr. desg.	Source			Amps. Watts CP	Volts	Bulb	Base	Filament			Life hours	Railroad use	Principal railroads using
		GRS Dwg. No.	WE W-G	US&S PC. No.					Shape	LCL	Tolerance			
501	25A-120V	44775-10	W-G		25W	120	A-19 I.F.	S. Med	C-9	A-Bulb $2\frac{1}{2}$ G-Bulb $\frac{3}{4}$		1,000	CTI	B&O-CN-CB&Q-L&N
502	No. 63	48088-4	W-G	97497	3CP	6-8	G-6	SC	C-2R			1,000	IND-LL-CTI	C&NW-CB&Q-CMStP&P-Erie-IC-IGN-NC&StL-NYC-SP
503	No. 63K		W-G	120467	3CP	6-8	G-6	S. Can	C-2R	$1\frac{1}{2}$ $\frac{3}{4}$		1,000	CTI	C&NW-CMStP&P-IC-MKT-N&W
504	No. 64		W-G	95829	3CP	6-8	G-6	DC	C-2R	$\frac{3}{4}$		1,000	IND-CTI	AT&SF-B&O-C&NW-CB&Q-Erie-IC-LV-L&N-NYC-N&W-NP-Sou-T&P
505	No. 67	48088-5	W-G	120270	3CP	12-16	G-6	SC	C-2R	$1\frac{1}{2}$ $\frac{3}{4}$		1,000	IND-LL-CTI	CMStP&P-PRR
506	No. 67K		W-G	95341	3CP	12-16	G-6	S. Can	C-2R	1		1,000	IND-LL-CTI	ACL-B&O-CP-C&O-C&NW-CB&Q-CMStP&P-Erie-IC-L&N-NYC-N&W-Sou-IC
507	No. 68	48088-6	W-G	116342	3CP	12-16	G-6	DC	C-2R	$1\frac{1}{2}$ $\frac{3}{4}$		1,000	IND-LL-CTI	CMStP&P-Erie-IC-L&N-NYC-N&W-Sou-IC
508	No. 89	48088-8	W-G		6CP	12-16	G-6	SC	C-2R	$\frac{3}{4}$		750	LL	FDDM&S-SL
509	No. 71	48088-3	W-G		3CP	18-24	G-6*	SC	C-2V	$\frac{3}{4}$		200	LL	LV
510	No. 71K		W-G	133192	3CP	18-24	G-6*	S. Can	C-2V	$1\frac{1}{2}$ $\frac{3}{4}$		200	IND	CMStP&P-MKT
511	No. 71M		W-G	120226	3CP	18-24	G-6*	S. Min	C-2V	$\frac{3}{4}$		200	IND-CTI	CMStP&P-Erie-PRR
512	No. 72		W-G	137964	3CP	18-24	G-6*	DC	C-2V	$\frac{3}{4}$		200	IND	T&NO
513	HDLT		W-G	95268	36W	120	G-18 $\frac{1}{2}$ *	S. Med	C-5	$2\frac{1}{2}$ $\frac{1}{4}$	$\frac{5}{64}$	1,000	CLT	AT&SF-CofP-NC&StL-RF&P-Union
514	No. 1133	34866-66	W-G		32CP	6-8	RP-11	SC	C-2V	RP-Bulb $1\frac{1}{4}$ S-Bulb $1\frac{1}{4}$	0.04-.03	200	CLT	Sou
515	6S6-120V		W-G	186579	6W	120	S-6*	S. Can	C-7A	$1\frac{1}{2}$ $\frac{1}{8}$		1,500	IND-CTI-LL	CNJ-CMStP&P-IC-L&N-PRR
516	No. 87	48088-9	W-G	15CP		6-8	S-8	SC	C-2R	$1\frac{1}{2}$ $\frac{1}{8}$		300	CTI	NYC
517	No. 1129	34866-27	W-G	21CP		6-8	S-8	SC	C-2R	$1\frac{1}{4}$	0.04-.03	200	CLT	AT&SF-CRI&P-LV-NYC-N&W-SP-T&P
518	No. 1141	34866-32	W-G	208229	21CP	12-16	S-8	SC	C-2R	$1\frac{1}{4}$	0.04-.03	500	SEM-CLT-PLT-SLT-XNG-CGA	B&O-CG-CMStP&P-DL&W-LV-L&N-NYC-N&W-PRR-RF&P-Sou
519	No. 1142		W-G	21CP		12-16	S-8	DC	C-2R	$1\frac{1}{4}$	0.04-.03	500	SEM-CLT	NYC
520		34866-77	W-G	15W		120	S-11*	SC	C-7A			750	SEM	B&O-C&NW
521	10S14-120V	44775-4	W-G	69494	10W	120	S-14*	S. Med	C-9	$2\frac{1}{2}$ $\frac{1}{4}$		1,500	SEM	B&O-C&M-CRI&P-MP-NYC-T&P
522	4A	52879	W-G		0.17-.21A	4	T-2*	SL.1	C-6	T-Bulb			CTI	C&O-CI&L-GN-P&PU
523	E3		WE		0.12-.16A	6	T-2*	SL.2	C-21				CTI	NYC
524	6A		G	240191	0.12-.16A	6	T-2*	SL.3	C-21				CTI	B&O
525	8A		G	240192	0.08-.10A	8	T-2*	SL.3	C-21				CTI	AT&SF-CRI&P
526	G1		WE		0.085-.10A	8	T-2*	SL.2	C-21				CTI	AT&SF-MP-UP
527	J1		WE		0.23-.27A	10	T-2*	SL.2	C-21				CTI	ACL-CB&Q-CMStP&P-CRI&P-StLSF-SAL-SP

ACTIVITY GROUP TABLE INCANDESCENT ELECTRIC LAMPS FOR RAILROAD SIGNAL PURPOSES—COMMERCIAL TYPES

Item No.	Mfr. desg.	Source			Amps. Watts CP	Volts	Bulb	Base	Filament			Life hours	Railroad use	Principle railroads using
		GRS Dwg. No.	WE W-G	US&S PC. No.					Shape	LCL	Tolerance			
528	10B	52879-1	G	240193	0.23-0.27A	10	T-2*	SL.2	C-21	T-Bulb	(Contd.)	3,000	CTI	ACL-A&S-B&M-C&O-CMStP&P-CRI&P B&O-B&M-C&NW-CB&Q-LV-L&N-NP-Sou
529	12A		W-G		0.09-0.11A	12	T-2*	SL.1	C-21				CTI	
530	12A	52879-6	G	240185	0.09-0.11A	12	T-2	SL.3	C-21	Carbon C-21		3,000	CTI	C&EI-CB&Q-CMStP&P-DL&W-Erie-L&N-N&W-StLSF-StLSW-T&NO AT&SF-CB&Q B&O-B&M-C&O-DM&IR-EJ&E-Erie-GN-LV-L&N-NYC-StLSF-SAL C&O-GTW-PRR-StLSF-W&LE CRI&P-D&M-PRR CRI&P CI&L-NP-Rdg-UP PRR
531	2F		WE		0.105-0.12A	12	T-2*	SL.2	Carbon				CTI	
532	12C	52879-3	W-G		0.17A	12	T-2*	SL.1	C-21	Carbon C-21		3,000	CTI	
533	12C		G	240199	0.17A	12	T-2*	SL.3	C-21				CTI	
534	15A	52879-2	G	240186	0.09-0.11A	15	T-2*	SL.3	C-21	Carbon C-21		3,000	CTI	C&O-CRI&P-CB&Q-DL&W-NYNH&H-StLSF-SAL-Wab-UP-WP AT&SF-B&M-CMStP&P-CRI&P-Erie NYC-P&LE CP-C&NW-D&M-LV-L&N-NYC-NYNH&H-NP-Sou
535	2C		WE		0.103-0.120A	15	T-2*	SL.2	Carbon				CTI	
536	16A	52879-5	W-G		0.09-0.11A	16	T-2*	SL.1	C-21	Carbon C-21		3,000	CTI	AT&SF-B&M B&O-CB&Q-D&H-D&M-StLSF-Sou-T&P-UP D&H-LV ACL-PRR PRR
537	16A		G	287000	0.09-0.11A	16	T-2*	SL.3	C-21				CTI	
538	18A	52879-9	G	240194	0.035-0.045A	18	T-2*	SL.3	C-21	Red coating		3,000	CTI	
539	B2		WE		0.036-0.048A	18	T-2*	SL.2	C-21				CTI	
540	2R	52879-4	WE		0.09-0.12A	18	T-2*	SL.2	Carbon	Yellow coating		3,000	CTI	T&P-CB&Q GTW-T&P GTW-T&P GTW-T&P
541	20A		G	286763	0.06-0.085A	20	T-2*	SL.3	C-21				CTI	
542	24E	52879-7	W-G		0.032-0.038A	24	T-2*	SL.1	C-21	Green coating		200	IND-CTI	
543	2G		WE		0.075-0.115A	24	T-2*	SL.2	Carbon				CTI	
544	24D	52879-8	W-G		0.09-0.11A	24	T-2*	SL.1	C-21	1% coating		200	CTI	B&O
545	24D-R		W-G		0.09-0.11A	24	T-2*	SL.1	C-21				CTI	
546	C2	43198-11	WE		0.032-0.044A	36	T-2*	SL.2	C-21	1% coating		3,000	CTI	B&O
547	36A		G	240197	0.035-0.045A	36	T-2*	SL.3	C-5				CTI	
548	40B	43198-17	G	283860	0.035-0.045A	40	T-2*	SL.3	C-5	1% coating		3,000	CTI	
549	No. 40		W-G		0.15A	6-8	T-3/4*	S. Min	C-2R				IND	
550	No. 40Y	43198-18	W-G		0.15A	6-8	T-3/4*	S. Min	C-2R	1% coating		3,000	CTI	
551	No. 40R		W-G	296704	0.15A	6-8	T-3/4*	S. Min	C-2R				CTI	
552	No. 40G	43198-22	W-G		0.15A	6-8	T-3/4*	S. Min	C-2R	1% coating		3,000	CTI	
553	No. 1488		W-G		0.15A	14	T-3/4*	B. Min	C-2R				CTI	
554	No. 1488-R	57026-3	W-G		0.15A	14	T-3/4*	B. Min	C-2R	Red coating		200	CTI	
													CTI	

(Revision of A.A.R. Signal Section Specification 231-50)
A.A.R. SIGNAL SECTION SPECIFICATION 231-52.

ILLUMINATED INDICATORS AND SIGNS

1. *Purpose.*

(a) This specification is for the purpose of providing for illuminated indicators and signs which display a legend only when illuminated from inside the case. It sets forth specific detail requirements representing modern signal practice recommended for new installations and for replacement on existing installations when general renewal or replacement becomes desirable.

2. *Specifications and drawings.*

(a) Specifications and drawings referred to in the body of this specification form an essential part hereof.

(b) Manufacturer shall furnish with his tender, drawings forming an essential part thereof.

3. *Tender.*

(a) The tender shall be for a product meeting the requirements of this specification in its entirety.

4. *Purchaser's order requirements.*

(a) The following additional requirements will be shown on the Purchaser's order:

1. Purchaser's drawing or other reference.
2. Supporting bracket as required:
 - (a) For front of mast.
 - (b) For side of mast.
 - (c) For 4 in., 5 in., 6 in., or 8 in. pipe.
3. Lamp voltage and wattage rating.
4. Legend as required, per section 9-b.
5. Inspection and tests as required.
6. Alternate requisites as required.

5. *Alternates.*

(a) The provisions contained in the alternate requisites section of this specification form a part hereof only when substituted by Purchaser's order for the provisions contained in this specification.

6. *Material and workmanship.*

(a) Material and workmanship shall be first-class in every respect.

7. Design.

(a) Electric light unit shall be designed to conform to Drawing 1481 or 1514.

(b) Case and door shall be cast aluminum alloy in accordance with A.S.T.M. current Specification B 26, alloy number and treatment as required. *R-7-b.

(c) The case shall be designed to enclose a 14 in. diameter reflector and an electric lamp mounted at its focal point.

(d) The door shall be designed to support a convex roundel and associated parts necessary to produce the legend desired.

(e) Design shall be such that the reflector, roundel and associated parts may be cleaned without disturbing the adjustment of the lamp.

(f) Door and roundel shall be provided with durable water-proof gaskets which shall be fastened securely in place to prevent the entrance of dust or moisture.

(g) Door shall open in front, be hinged at side or bottom, and be provided with means for compressing the door against the housing.

(h) The case shall be designed for attachment to bracket 14851, Drawing 1485, and when mounted shall conform to Drawing 1482, 1483, 1515 or 1516.

(i) The legend shall be legible only when illuminated from inside the case.

1. An inner convex roundel of clear glass shall have the legend outlined in a black background of baked enamel.

2. An outer convex roundel of clear glass with the concave surface lightly sand-blasted shall be separated approximately 1 in. from the inner roundel.

3. A suitable arrangement of non-reflecting black honey-comb cells shall fill the space between roundels so as to screen the interior from the possibility of illuminating the legend by reflection of external light.

(j) Machine screws, washers, bolts, nuts and hinge pins shall be of corrosion-resisting metal or suitably plated. Zinc or cadmium shall not be used on parts carrying current.

(k) A breather opening with suitable filter shall be provided at bottom of case.

8. Terminals and wiring.

(a) Terminals in the case shall be conveniently located and shall be mounted on insulating block or blocks.

(b) Flexible copper wires not less than No. 18 A.W.G. single conductor, suitably insulated, shall be provided between lamp receptacle and terminals and be securely fastened to prevent breakage.

(c) Wire eyelets shall be provided on each wire attached to terminal posts.

* Alternate requisites section.

9. *Roundels.*

(a) Roundels shall be of clear glass 14 inches in diameter, convex, and treated per section 7-i.

(b) Legend shall be as specified by the Purchaser:

1. "No Right Turn"—Drawing 1487.

2. "No Left Turn"—Drawing 1487.

3. "S"—Drawing 1513.

4.

10. *Hood.*

(a) A hood shall be provided over the outer roundel projecting no less than 10 in. substantially at right angles to the case and extending around the entire upper half of the roundel.

(b) Hood shall be made of copper-bearing sheet steel, not less than 0.0478 in. thick, suitably treated to resist corrosion.

11. *Reflector.*

(a) The reflector shall be of glass of the Mangin or parabolic type and shall have a reflecting surface of proper diameter to project substantially parallel light rays in a cylindrical beam equal to the effective diameter of the roundel used.

(b) The reflector shall be constructed as follows:

1. The reflective backing shall consist of a heavy homogeneous coating of pure metallic silver, evenly applied. The coating shall be applied over clean smooth glass and shall be applied in such a manner that no foreign substance remains between it and the glass. The coating shall adhere firmly and so closely to the glass that the admission of any foreign substance will be prevented.

2. Over the silver there shall be applied electrolytically a heavy coat of metallic copper of such thickness as to reinforce the silver reflective backing and protect it from atmospheric conditions. The copper shall extend over the edge of the mirror at least one-fourth the thickness of the glass. Over the copper backing shall be placed one or more coats of paint or enamel of such quality as to render the greatest resistance possible to the admission of moisture or gases. The paint or enamel shall withstand ordinary handling without scratching or chipping.

12. *Reflector tests.*

(a) Reflectors shall meet the following test:

1. The reflector shall be immersed for 24 hours at room temperature in a solution composed of clean water and 20 per cent by weight of salt. It shall then be removed from the salt solution and rinsed in clean water, after which it shall be placed in clean water at room temperature and gradually heated to a temperature of 170 deg. F. and maintained at that temperature for 4 hours. The reflector shall

12. *Reflector tests.*—Continued.

then be removed from the water and placed in dry air at 170 deg. F. for 4 hours.

2. After this test, the backing on the reflector shall show no chipping, cracking or softening of the coatings and shall show no separation of the backing into layers, or from the mirror surface, and no appreciable change in the color of the backing or the silver reflecting surface.

13. *Receptacle.*

(a) Case shall be provided with a candelabra single contact bayonet lamp receptacle on rigid support so that a $\frac{1}{64}$ in. precision based lamp having a light center length of $1\frac{1}{4}$ in. will have its filament at the focal point of reflector. Receptacle shall be insulated from the case and reflector support.

(b) Receptacle shall be adjusted and sealed in position at the factory. *R-13-b.

14. *Range and spread.*

(a) The legend, when illuminated by a 10-volt 25-watt lamp of 1,000 hours design life, based accurately to $\frac{1}{64}$ in. precision, operating at 9 volts, shall have, in bright sunlight:

1. Light visibility range:

(a) In excess of 300 ft. for "No Right Turn" or "No Left Turn" legend.

(b) In excess of 800 ft. for "S" legend.

2. Message legibility range:

(a) 200 ft. for "No Right Turn" or "No Left Turn" legend.

(b) 500 ft. for "S" legend.

(c) A satisfactory close-up indication shall be displayed.

15. *Background.*

(a) Background shall not be provided. *R-15-a.

16. *Painting.*

(a) Cast aluminum case and door shall be given an approved surface treatment to provide for paint adherence.

(b) Primer coat shall be zinc chromate type.

(c) Finish coats for case and door shall be in accordance with treatment for castings per Specification 120, Manual Part 110.

(d) Other metal parts shall be painted in accordance with Specification 120, Manual Part 110.

* Alternate requisites section.

17. *Binding posts.*

(a) Nuts and washers shall conform to Drawing 1070 for 14-24 post.

(b) Binding posts shall conform to Drawing 1070 or 1078 and shall have 14-24 thread.

(c) Binding posts shall be mounted so they cannot be turned in the base or frame to which applied. They shall be properly insulated from each other and other metallic parts.

18. *Dielectric requirements.*

(a) Electrical apparatus assembled shall withstand for 1 minute an insulation test, at place of manufacture, of 3,000 volts a.c. between all parts of electric circuits and other metallic parts insulated therefrom, except the lamp receptacle which shall withstand for 1 minute an insulation test of 800 volts a.c.

(b) With the exception of the lamp receptacle, a surface leakage distance of not less than $\frac{1}{4}$ in. shall be provided between any exposed metallic part of the apparatus carrying current and any other metallic part thereof.

19. *Identification.*

(a) Case or door shall be plainly marked with Manufacturer's name or trade-mark.

20. *Inspection.*

(a) Purchaser may inspect the material or product at all stages of manufacture.

(b) Purchaser may inspect the completed product to determine that the requirements of this specification have been met.

(c) If product has not been accepted at point of production and if, upon arrival at destination, it does not meet the requirements of this specification, it may be rejected, and the Manufacturer, upon request, shall advise the Purchaser what disposition is to be made of the rejected product. Manufacturer shall pay all freight charges.

(d) If Purchaser is to make inspection at point of production it shall be so stated on Purchaser's order.

21. *Tests.*

(a) Tests may be made at point of production, or on samples submitted, and may also be made at destination.

(b) Manufacturer shall give the Purchaser sufficient notice of time when the material or product will be ready for testing.

(c) Manufacturer shall provide, at point of production, apparatus and labor for making required tests under supervision of the Purchaser.

(d) If tests are to be made at point of production, it shall be so stated on Purchaser's order. The Purchaser shall indicate which of the tests herein specified are to be made and what portion of the material or product shall be tested.

22. *Packing.*

(a) Product shall be so assembled or packed as to permit convenient handling and to protect against loss or damage during shipment.

23. *Marking.*

(a) Purchaser's order, requisition and package number, name of Consignor, and name and address of Consignee, shall be plainly marked on outside of packages and on tags attached to loose pieces.

(b) Detail list of loose pieces, packages and their contents shall be furnished for each shipment.

24. *Warranty.*

(a) Manufacturer shall warrant the product covered by this specification to be free from defects in material and workmanship under ordinary use and service, his obligation under this warranty being limited to manufacturing, at point of production, any part or parts to replace those which shall be found defective within 1 year after shipment to the Purchaser. This warranty shall not apply to any product which shall have been repaired or altered in any way by anyone other than the Manufacturer thereof, so as to affect, in the Manufacturer's judgment, its proper functioning or reliability, or which has been subjected to misuse, negligence or accident.

Alternate requisites.

R-7-b.

Case and door shall be one of the following, as specified by Purchaser:

1. Die cast alloy, in accordance with A.S.T.M. current Specification B 86, Alloy XXI or XXIII.
2. Cast iron, in accordance with A.S.T.M. current Specification A 48, Class 20.

R-13-b.

Receptacle shall be adjusted and fixed in position at the factory, but not sealed.

R-15-a.

1. Background shall be provided and shall be copper-bearing sheet steel not less than 0.0478 in. thick. It shall be adaptable for assembly in the field without use of special tools. It shall be

Alternate requisites.—Continued.

painted with a suitable^m primer and non-reflecting black finish coat per Specificationⁿ 214, Manual Part 221.

2. Diameter shall be:

- (a) 30 in.
- (b) 35 in.
- (c)

Action Recommended

Acceptance for submission to letter-ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Specification 231-50—"No Right Turn"—"No Left Turn" Illuminated Sign, Manual Part 237.

COOPERATIVE REPORT

AMERICAN STANDARDS ASSOCIATION
SECTIONAL COMMITTEE ON THE STANDARDIZATION AND
UNIFICATION OF SCREW THREADS—PROJECT B1*

W. G. Brown, Representative

Because of A.S.A. B1.1-1935 having been revised and published as A.S.A. B1.1-1949, Unified and American Screw Threads for Screws, Bolts, Nuts and Other Threaded Parts, A.S.A. B1.2-1941 was revised, approved September 6, 1951 and published as A.S.A. B1.2-1951, Screw Thread Gages and Gaging.

Action Recommended

Acceptance as information.

* Previous report on this subject appears in A.A.R. Signal Section 1950 Proceedings, Vol. XLVIII, pp. 288 and 411.

COMMITTEE VII—MATERIALS RESEARCH

Personnel

E. A. Burgin, Chairman
K. Chamberlain, Vice-Chairman

F. E. Beutler	J. C. Hoffman
A. L. Essman	Curtis Kies
G. E. Goeppert	C. T. Marak
T. T. Hart	J. Mooney, Jr.
W. W. Hartzell	J. A. Moore
C. W. Hoffman	T. B. Thompson
W. K. Waltz	

Signal Section, A.A.R.:

The following outline of work has been assigned:

1. Revision of Manual.
2. Indexing signal literature.
3. Investigate and report on rust preventives, segregating into classifications.
4. Investigate and report on means for determining colors for target enamel covered in Specification 227, Manual Part 235, and prepare recommended colors.
5. Investigate and report on the use of stainless steel guy and messenger strand.
6. Investigate and report on wash primers.
7. Investigate and report on test installations of aluminum or newer or better steel alloys for relay and instrument housings.
8. Investigate and report on preparation of aluminum surfaces for painting.
9. Specification for ready-mixed aluminum paint.

The Committee submits for consideration, reports on the following subjects*:

1. Revision of Specification 200-43, Manual Part 62.
Revision of Specification 120-51, Manual Part 110.
Revision of Specification 13-39, Manual Part 58.
Requisites for Fabricated Fibre Parts for Track Insulation.
Revision of Specification 77-41, Manual Part 111.
Revision of Specifications for Various Types of Non-Ferrous Metals and Alloys, Manual Part 220.
Revision of Specification 217-46, Manual Part 222.
Revision of Specification for Signal Colors Exclusive of Signal Glasses, Manual Part 273.

* Suggestions or criticisms should be submitted in writing to the Chairman of the Committee on or before September 1, 1952.

3. Field uses of rust preventives.
5. Use of stainless steel guy and messenger strand.
6. Wash primers.
8. Preparation of aluminum surfaces for painting.
9. Specification 259-52.

Explanatory

Manual Part 273, Specification for Signal Colors Exclusive of Signal Glasses, refers to color samples prepared by the Federal Bureau of Aeronautics and the U. S. Army. Reproductions of these colors now appear in the recently issued Federal Specification TT-C-595, Colors (for) Ready-Mixed Paints, which can be purchased from the Superintendent of Documents and since it is relatively difficult to obtain color samples from the Bureau of Aeronautics, Committee VII herein presents a revision of Manual Part 273 in which reference is made to color samples appearing in Federal Specification TT-C-595.

Information

Specifications, etc., of other organizations referred to in the report of this Committee may be procured from the following:

A.S.T.M.—American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.

Federal Specifications—Superintendent of Documents, Government Printing Office, Washington 25, D. C.

Disposition of 1951 Letter Ballot Subjects

The following subjects presented by Committee VII at the 1951 Annual Meeting were submitted to letter ballot and officially approved:

Specification 144-51—Dry Process Porcelain Insulation—Now in Manual Part 80.

Specification 120-51—Painting—Now in Manual Part 110.

Specifications for Various Types of Steel—Now in Manual Part 154.

(Revision of A.A.R. Signal Section Specification 200-43)
A.A.R. SIGNAL SECTION SPECIFICATION 200-52.

ALUMINUM PAINT (READY-TO-MIX)

1. *Purpose.*

(a) This specification is for the purpose of providing for a ready-to-mix, aluminum paint applicable for use on metal and masonry surfaces. It sets forth specific detail requirements representing modern signal practice recommended for the painting of new installations and for the repainting of existing installations when general renewal or repainting becomes desirable.

2. *Specifications.*

(a) Specifications referred to in the body of this specification form an essential part hereof.

3. *Tender.*

(a) The tender shall be for products meeting the requirements of this specification in its entirety.

4. *Purchaser's order requirements.*

(a) The following additional requirements will be shown on the Purchaser's order:

1. Size and kind of containers.
2. Inspection and tests as required.
3. Alternate requisites as required.

5. *Alternates.*

(a) The provisions contained in the alternate requisites section of this specification form a part hereof only when substituted by Purchaser's order for the provisions contained in this specification.

6. *Material and workmanship.*

(a) Material and workmanship shall be first-class in every respect.

7. *Requirements.*

(a) General.

1. The paint shall consist of two parts, aluminum pigment and vehicle, supplied in separate containers, which shall be mixed just prior to application.
2. The paint shall be suitable for brush or spray application.

7. *Requirements.*—Continued.(b) *Pigment.*

1. The pigment shall consist of commercially pure aluminum in the form of fine flakes uniformly dispersed in mineral spirits to form a paste which shall conform to the following requirements (*R-7-b-1):

(a) At least 65 per cent by weight of the paste shall be matter non-volatile at 221 to 230 deg. F. (essentially aluminum flakes).

(b) The paste shall contain an easily extracted fatty or oily matter (polishing lubricant) in the amount of 3 per cent maximum, by weight of the paste.

(c) When the paste is washed through sieves with alcohol or mineral spirits, not more than 1 per cent, by weight of the paste, shall be coarse particles retained on a No. 325 sieve.

(d) The aluminum flakes shall remain permanently in suspension in the paste and there shall be no separation of mineral spirits from the aluminum flakes in the container.

(e) The leafing properties of the aluminum pigment paste shall be not less than 50 per cent.

(f) The mineral spirits in which the aluminum flakes are dispersed to form the pigment paste, shall be completely volatile at 220 deg. F. and shall be in accordance with current Federal Specification TT-T-291, Thinner; Paint, Volatile Mineral Spirits (Petroleum Spirits).

(g) The pigment paste shall not contain mica, fillers or other adulterants and the total impurities (other than fatty and oily matter) shall be not more than 0.7 per cent by weight of paste.

(c) *Vehicle.*

1. The vehicle shall be an alkyd resin base varnish and shall conform to the following requirements (*R-7-c-1, No. 1 or No. 2):

(a) Phthalic anhydride content: Not less than 25 per cent (based on solids content).

(b) Thinner: The volatile thinner shall be free from toxic hydrocarbons, such as benzol or chlorinated hydrocarbons.

(c) Driers: The vehicle shall be free from lead, manganese, calcium or zinc driers.

(d) Rosin or rosin derivatives content: None.

(e) Clarity: Clear, transparent and free from sediment and suspended matter when examined by transmitted light.

* Alternate requisites section.

7. *Requirements.*—Continued.

(f) Viscosity: Between 0.65 and 1.25 poises at 77 deg. F., corresponding to Tubes B to E of the Gardner-Holdt Air Bubble Viscometer.

(g) Flash point: Not less than 86 deg. F. in a closed cup tester.

(h) Non-volatile matters: Not less than 48 per cent, by weight, of non-volatile oils and resins.

(i) Acid number: Not more than 7 (based on non-volatile content).

(j) Skinning: None after 48 hours in a three-fourths filled, tightly closed container.

(k) Flexibility (cold cracking): A flow out film on a No. 28 gage tin plate panel, air-dried 18 hours and then baked at 179.6 to 185 deg. F. for 2 hours; suddenly chilled to 32 deg. F. and then bent rapidly 180 deg. around a $\frac{1}{8}$ in. diameter rod, shall not show cracking or loosening of the film.

(l) Adhesion: The film on the bent portion of panel used in section 7-c-1-k, shall show "good adhesion" when tested with a knife edge, in accordance with paragraph 15K of U. S. Army Specification No. 3-1F.

(m) Appearance: A flow out film on colorless glass, air-dried 18 hours and then baked at 180 to 185 deg. F. for not less than 2 hours, shall be hard, tough, smooth, transparent and free from defects such as checking, dulling or wrinkling.

(n) Water immersion resistance: A flow out film on a No. 28 gage tin plate panel, air-dried 48 hours, shall withstand immersion in cold water for 18 hours without whitening and shall show only slight dulling. After removal from the water for 2 hours, the original gloss and hardness shall return.

(o) Gasoline immersion resistance: A flow out film on a No. 28 gage tin plate panel, air-dried 72 hours, shall withstand immersion in straight run gasoline for 24 hours without loss of gloss or change in appearance. After removal from the gasoline and air-dried 4 hours, the film shall have regained its initial hardness and toughness. There shall be no dissolution effect on the lower immersed edge.

(p) Drying time: Aluminum paint made with this vehicle, when applied to a metal panel and allowed to air-dry in a vertical position, shall require not less than 1 hour nor more than $2\frac{1}{2}$ hours to set to touch and shall dry hard and tough in not more than 18 hours at a temperature of 68 to 86 deg. F.

(q) Mixing properties: Aluminum paint made with this vehicle by thoroughly mixing with the specified pigment in the proportion of 2 lbs. of pigment to 1

7. *Requirements.*—Continued.

gallon of vehicle, when applied to a vertical, smooth, metal surface, shall show good leafing property, satisfactory brushing and leveling properties and shall not break or sag.

8. *Mixing.*

(a) Aluminum paint made to this specification shall be mixed on the job and only enough for one day's work shall be mixed at one time. Any paint remaining after this period may be combined with freshly prepared paint if it does not exceed 10 per cent of the newly-mixed paint.

(b) The paint shall be mixed in the proportion of 2 lbs. of pigment to 1 gallon of vehicle. The weighed amount of pigment shall be placed in a suitable mixing container and a measured volume of vehicle shall be gradually added to it with continuous stirring until a uniform mixture is obtained. Each time paint is removed from the mixing container, the paint, before removal, shall be thoroughly stirred to maintain the proper consistency. The paint shall also be occasionally stirred during use.

9. *Application.*

(a) Application of aluminum paint (ready-to-mix) shall be in accordance with Specification 120, Manual Part 110.

10. *Tests.*

(a) Tests may be made at point of production, or on samples submitted, and may also be made at destination.

(b) Manufacturer shall give the Purchaser sufficient notice of time when the material or product will be ready for testing.

(c) Manufacturer shall provide, at point of production, apparatus and labor for making required tests under supervision of the Purchaser.

(d) If tests are to be made at point of production, it shall be so stated on Purchaser's order. The Purchaser shall indicate which of the tests herein specified are to be made and what portion of the material or product shall be tested.

(e) Tests required in sections 7-b and 7-c and in the alternate requisites section, except as otherwise specified, shall be conducted in accordance with the methods described in Federal Specification TT-P-141b as follows:

Test for	Method of testing as shown in Fed. Spec. TT-P-141b
Phthalic anhydride content.....	702.1
Rosin or rosin derivatives.....	503.1
Driers.....	723.1
Viscosity.....	427.1
Flash point.....	429.1
Non-volatile matter.....	405.3
Acid number.....	507.3

10. *Tests.*—Continued.

Test for	Method of testing as shown in Fed. Spec. TT-P-141b
Skinning.....	414.1
Elasticity and toughness.....	415.1
Flexibility (cold cracking).....	622.3
Gas test.....	416.1
Draft test.....	417.1
Water immersion resistance.....	601.1
Gasoline immersion resistance.....	601.1
Alkali and acid immersion resistance.....	601.1
Drying time.....	406.1
Mixing properties.....	455.1

11. *Inspection.*

(a) The products furnished under this specification may be accepted upon Manufacturer's certificates of guarantee insuring that they are in accordance with the specification. If on arrival at destination the products are found not to meet the requirements of the specification they may be rejected and the Manufacturer, upon request, shall advise the Purchaser what disposition is to be made of the rejected products. Manufacturer shall pay all freight charges.

12. *Containers.*

(a) Products shall be furnished in duplex containers, 1 gallon cans, or steel drums as specified by the Purchaser.

13. *Packing.*

(a) Products shall be so assembled or packed as to permit convenient handling and to protect against loss or damage during shipment.

14. *Marking.*

(a) Purchaser's order, requisition and package number, name of Consignor, and name and address of Consignee, shall be plainly marked on outside of packages and on tags attached to loose pieces.

(b) Detail list of loose pieces, packages and their contents shall be furnished for each shipment. Where carload shipments are made, routing and car identification shall be shown.

15. *Warranty.*

(a) Manufacturer shall warrant the products covered by this specification to be free from defects in material and workmanship under ordinary use and service, his obligation under this warranty being limited to manufacturing, at point of production, any part or parts to replace those which shall be found defective within one year after shipment to the Purchaser. This warranty shall not apply to any product which has been subjected to misuse, negligence or accident.

Alternate requisites.

R-7-b-1.

The pigment shall consist of commercially pure aluminum powder in the form of fine polished flakes and shall conform to the following requirements:

(a) At least 99 per cent, by weight of the powder, shall be matter non-volatile at 221 to 230 deg. F. (essentially aluminum flakes).

(b) When the powder is washed through sieves with alcohol or mineral spirits, not more than 1.5 per cent, by weight of the powder, shall be coarse particles retained on a No. 325 sieve.

(c) The powder shall contain an easily extracted fatty or oily matter (polishing lubricant) in the amount of 4 per cent maximum, by weight of the powder.

(d) The leafing properties of the aluminum pigment powder shall be not less than 50 per cent.

(e) The pigment powder shall not contain mica, filler or other adulterants and the total impurities (other than fatty and oily matter) shall not be more than 1 per cent by weight of powder.

R-7-c-1, No. 1.

The vehicle shall be a phenolic resin base varnish of a long oil type and shall conform to the following requirements:

(a) Phenolic resin content: 100 per cent (based on solids content).

(b) Oil: Shall be a suitable vegetable drying oil as is necessary to meet the requirements of this specification.

(c) Thinner: Shall be free from toxic hydrocarbons, such as benzol or chlorinated hydrocarbons.

(d) Driers: The vehicle shall be free from lead, manganese, calcium or zinc driers.

(e) Rosin or rosin derivatives content: None.

(f) Clarity: Clear, transparent and free from sediment and suspended matter when examined by transmitted light.

(g) Viscosity: Between 0.65 and 1.25 poises at 77 deg. F., corresponding to Tubes B to E of the Gardner-Holdt Air Bubble Viscometer.

(h) Flash point: Not less than 86 deg. F. in a closed cup tester.

(i) Non-volatile matter: Not less than 50 per cent, by weight, of non-volatile oils and resins.

(j) Elasticity and toughness: Shall pass a 100 per cent Kauri Reduction Test.

(k) Skinning: None after 48 hours in a three-fourths filled, tightly closed container.

(l) Gas and draft tests: Shall pass satisfactorily.

Alternate requisites.—Continued.

R-7-c-1, No. 1.—Continued.

(m) Water immersion resistance: Flow out films on No. 28 gage tin plate panels, air-dried 72 hours, shall withstand immersion in cold water for 96 hours and in hot water (167 deg. F.) for 6 hours without whitening, dulling, checking, blistering or showing other serious defect.

(n) Alkali and acid immersion resistance: Films applied to test tubes (dimensions 6 in. by 1 in.) by immersion in varnish to a depth of 4 inches and dried in an inverted position for 72 hours shall show no whitening, dulling, or visible attack when immersed to a depth of 2 inches in a 5 per cent solution of sodium hydroxide for 6 hours (at 68 deg. F.) and (a separate similar film) in a 4 per cent solution of acetic acid for 24 hours (at 68 deg. F.).

(o) Gasoline immersion resistance: A flow out film on a No. 28 gage tin plate panel, air-dried 48 hours, shall be immersed in straight run gasoline for 48 hours. After air drying for 2 hours, the film shall show no whitening, dulling, or visible attack.

(p) Drying time: Aluminum paint made with this vehicle, when applied to a metal panel and allowed to air-dry in a vertical position, shall require not less than 1 hour nor more than 3 hours to set to the touch and shall dry hard and tough in not more than 18 hours at a temperature of 68 to 86 deg. F.

(q) Mixing properties: Aluminum paint made with this vehicle by thoroughly mixing with the specified pigment in the proportion of 2 lbs. of pigment to 1 gallon of vehicle, when applied to a vertical, smooth metal surface, shall show good leafing property, satisfactory brushing and leveling properties and shall not break or sag.

R-7-c-1, No. 2.

The vehicle shall be and shall conform to the following requirements:

- (a)
- (b)
- (c)

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Specification 200-43—Aluminum Paint Suitable for Finishing Coats on Steel Structures, Manual Part 62.

(Revision of A.A.R. Signal Section Specification 120-51)
A.A.R. SIGNAL SECTION SPECIFICATION 120-52.

PAINTING

Proposed Revision

5. *General.*

(a) Paint prescribed for application to apparatus as covered in this specification shall be in accordance with the following:

2. Finishing paints and enamels.

(a) Aluminum Paint (Ready-to-Mix)—Specification 200, Manual Part 62.

(b) Aluminum Paint (Ready-Mixed)—Specification 259, Manual Part

(Present sections 5-a-2-b through 5-a-2-h become 5-a-2-c to 5-a-2-i, inclusive.)

8. *Application.*

(a) Paint may be applied by brushing, dipping or spraying and may be air dried or baked.

(b) When applying aluminum paint by brushing, care should be taken to make final strokes in the same direction. Excessive brushing will result in streaking and darkening. When applied by spraying, only sufficient pressure shall be used to ensure adequate distribution. Excessive pressure will result in a non-uniformity of the film.

(Present sections 8-b through 8-f become 8-c to 8-g, inclusive.)

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Sections 5-a-2 and 8 of Specification 120-51—Painting, Manual Part 110.

WASH PRIMERS

An effective method to protect metal surfaces against rust and corrosion has long been sought by industry. To be successful in this respect, the metal surface must be thoroughly treated by an initial coating which will be impervious to moisture, resistant to corrosive action, and at the same time provide a base upon which subsequent conventional paint primers and finishes may become firmly attached.

Prior to 1941 a generally accepted method for the surface pretreatment of metal was to cleanse the surface thoroughly, then apply a phosphoric acid type of treatment immediately after which paint coatings could be applied. This type of treatment in some instances did not assure satisfactory results, particularly when applied in very cold weather; the desired adhesive qualities were found to be lacking and subsequent paint coats would peel and blister.

The necessity for improvement in the surface treatment of the hulls of seagoing vessels became urgent at the outset of World War II and extensive research and development work followed, which resulted in the introduction of a new type of metal treatment. This treatment was subsequently classified as a "wash primer." (This term is a misnomer in that it does not require that the treatment be applied by washing, neither is it intended to replace other existing types of conventional primers. It is essentially a method employed in the treatment of metal surfaces prior to the application of existing types of conventional primers.) This wash primer was, and still is, furnished in two packages. One of the packages contained polyvinyl butyral resin mixed with insoluble zinc chromate combined with suitable solvents; the other package contained an acid diluent composed of phosphoric acid mixed with suitable solvents. The contents of the two packages were combined in the proportions recommended by the manufacturer.

As a result of this research and development, wash primers are now commercially available and are used extensively. It is claimed these wash primers will adhere strongly to steel, stainless steel, iron, galvanized iron, aluminum, magnesium, copper, brass, cadmium, nickel, chromium, zinc, and tin. Unlike most other primers, they may also be applied over slightly damp surfaces without loss of adhesion. Generally, wash primers can be expected to adhere more tightly to all surfaces than will most paints; however, it should be remembered that to produce the best results, the usual procedures with respect to surface cleanliness must be observed.

Wash primers may be applied by brushing, spraying, rolling, flowing, or dipping, although two-package systems are not generally used for dipping purposes due to the considerable amount wasted because of the relatively short stability life. As mixed primers quickly lose their effectiveness, becoming unfit for use after a period of 8 hours, application after that time is not recommended.

For best results a wash primer should be applied as soon as possible after the surface is cleaned. Being formulated with low solids and solvents having low surface tension, it will inherently penetrate into pits in the surface of the metal, but to ensure that complete coverage is effected, a second application should be made over seams and laps after the first application has dried. The recommended film thickness of the wash primer is 0.2 to 0.5 mil which is the normal

film thickness obtained with one application. On films thicker than 0.5 mil the drying is retarded and the resultant film has a tendency to remain spongy and porous. When applied at recommended film thickness the drying time at room temperature will not exceed 15 minutes; this can be reduced to a matter of seconds under a hot air blast. Such quick drying qualities permit the rapid application of succeeding paint coats.

Wash primers were originally formulated as a base for subsequent vinyl coatings. All other types of paint coatings show excellent adherence to wash primers except some pyroxylin lacquers. These, however, can be so formulated as to produce equally good results.

Realizing that there are some disadvantages in the use of a two-package type of wash primer: namely, in the transportation of the acid and pigmented base in separate containers, the mixing at the time of application, also the short stability life of the mixed product, a stable one-package wash primer was developed in January 1946 and offered to a number of paint companies for experimentation. This primer is a modified polyvinyl butyral solution containing approximately 12 per cent solids. It is claimed that this primer offers advantages over the two-package primer in the latitude allowed in pigmentation, and its greater stability characteristic permits its satisfactory use in a dip tank. It is slightly inferior to the two-package primer in adhesive property and its ability to resist rust creep.

A series of tests were conducted by one signal equipment manufacturer on an alkyd paint system consisting of one coat of zinc chromate and one coat of aluminum paint applied over a two-package type wash primer and over a one-package type wash primer. Both types of wash primers were effective in retarding rust creepage on cross-hatched portions of test panels partially immersed in salt water, also in fresh water, for a period of 600 hours. The tests showed that both types of wash primers were effective in retarding corrosion and rust creepage under an alkyd paint system. However, the two-package wash primer was more effective against rust creepage and it possessed superior adhesive qualities. Both types of wash primers, when used with paint coatings, showed excellent resistance to blistering and peeling. Panels not treated with wash primers, but with the same alkyd type zinc chromate and aluminum finish coats, were noticeably blistered after 600 hours partial immersion in salt water and also in fresh water.

Another series of tests of wash primers is being conducted by a second signal equipment manufacturer. These tests include the application of one coat of other paint primers as follows: wash primer and alkyd zinc chromate iron oxide primer; wash primer and alkyd red lead primer; wash primer and alkyd zinc chromate iron oxide primer followed by one coat of enamel and baked 3 hours at 375 deg. F. These tests have not progressed sufficiently to permit any conclusions at this time. A previous test of 14 months' duration indicated that a wash primer may be beneficial under high bake enamels without the use of a standard inhibitive primer between wash primer and top coat. This system showed no rust creepage away from scratches and the surface was without undue deterioration. In comparison, panels finished only with alkyd zinc chromate iron oxide primer followed with one coat of high bake enamel showed serious deterioration at the scratches and on the over-all surface.

Tests of wash primers on navy ship bottoms over a 6-year period are among the longest on record, and results for this length of time are reported as very

satisfactory. Wash primers are a new and rapidly expanding development which holds promise for valuable advances in the protection of metal surfaces against corrosion.

In conclusion, it should be understood that maximum benefits may be obtained from this method of treatment only when applied to clean metal surfaces such as can be expected under controlled shop and manufacturing conditions.

Action Recommended

Acceptance as information.

PREPARATION OF ALUMINUM SURFACES FOR PAINTING

Aluminum, like steel and iron, can be painted successfully if the surface is properly treated prior to painting. An understanding of aluminum surface conditions is necessary in order to select the proper method of surface treatment. The type of pigments used in the painting of aluminum is also important, and special consideration in their selection is necessary for some applications.

Unlike steel and iron, aluminum does not rust nor is mill scale ever present on its surface. The surface of aluminum, on contact with the air, becomes rapidly oxidized; the degree of oxidation, and resultant oxide film thickness, increases with the length of exposure. Another condition, incurred during the manufacturing processes, is that the surface of the aluminum becomes contaminated with a very thin film of oil or grease. This oily condition is particularly evident on rolled sheet aluminum due to the necessary use of light oil or oil emulsion on the metal as it passes through the rolling mill.

The oxide film condition is desirable when paint coats are to be applied. The film is tightly adherent to the metal, is relatively inert, and provides an excellent base for subsequent paint coats. Surface treatment is often provided to increase the oxide film thickness and so increase its efficiency to hold paint.

The oil and grease surface condition is not desirable if paint is to be applied and it must be removed. This may be accomplished by exposing the aluminum product to the weather for a month or so. If, however, outdoor exposure is impractical because of time or space, some type of surface treatment must be employed.

A type of treatment sometimes used is surface roughening. This is done by sand-blasting, scratch-brushing, or by the use of other abrasives. Usually this treatment is confined to the cleaning of sand castings, some die castings, and heavy structural sections. It should not be used on light sheet aluminum because of a tendency to warp the metal. Any form of surface roughening tends to destroy the natural oxide film and so reduces its adhesive quality for subsequent paint coatings. Because of these undesirable features, surface roughening is not recommended unless it is followed by a chemical treatment.

One simple form of chemical treatment involves the use of a solvent which may be applied by swabbing, or by actual immersion of the article in a dip tank. Following either method the surface must be dried by wiping with a clean cloth. This type of treatment does not insure an absolutely clean surface

as a thin film of grease usually remains on the surface as the solvent evaporates. This grease film can be removed by heating. A more desirable form of solvent cleaning is the solvent vapor degreasing method. This treatment which overcomes many of the objectionable features of ordinary solvent cleaning has proven adequate in many instances. The solvent cleaning methods just described may be used satisfactorily where severe conditions of service are not to be encountered. For more rigid conditions of service a chemical treatment is recommended.

There are a number of simple chemical treatments available which employ a dilute aqueous solution of phosphoric acid. These solutions usually contain alcohol or other organic solvents, and sometimes chromates, in addition to phosphoric acid. Apparently they cause a thin layer of aluminum phosphate to form on the surface of the metal. This film which is quite inert, acts to protect the aluminum and at the same time provides a satisfactory medium for paint adhesion. Inhibited alkaline cleaners of the sodium phosphate type are sometimes employed, but their use must be followed by a treatment with dilute chromic acid or phosphoric acid, of about 5 per cent concentration, and a final water rinse. Uninhibited alkaline cleaners, because of their corrosive action, must not be used. The phosphoric acid chemical treatment while quite satisfactory in many instances, has these limitations: it is inconvenient to use in freezing weather; it will wash off in the rain, if left unpainted; and under certain conditions thick deposits of phosphate may form thereby affecting its adhesive qualities. Some of these deficiencies are overcome by a wash primer type of treatment.

A wash primer known as a two-package type consists of polyvinyl butyral resin mixed with insoluble zinc chromate combined with suitable solvents which are mixed with an acid diluent composed of phosphoric acid mixed with suitable solvents just prior to their use. This treatment causes a thin resinous film to be firmly attached to the surface of the aluminum which in addition to providing excellent corrosion resistance also furnishes a desirable base to which subsequent paint coats may be applied. It has some disadvantages in that it must be used within 8 hours after mixing and it is furnished in two separate packages. Another wash primer, furnished in one package, has been developed to overcome the objection to the short stability life of the two-package type. This primer has shown excellent results, but its use is not as extensive as is the two-package type. These primers may be applied successfully in freezing weather and they may also be applied over damp surfaces. The usual surface cleanliness of the metal must also be observed before applying wash primers.

In addition to the several treatments previously described there are also available hot chemical treatments which have desirable characteristics. The time of processing is materially reduced and the entire operation of cleaning and painting can be speeded up. Treatments of this type usually require rather extensive equipment such as dip or spray tanks, a conveyor line, drying ovens, etc. The treatment is applied at a temperature of 140 to 160 deg. F. The parts to be treated should be precleaned by vapor degreasing or by means of a hot inhibited alkaline dip followed by a hot water rinse.

There are several proprietary processes of this type which are effective. These treatments are multiple-step processes involving a preliminary cleaning and rinse, chemical treatment, rinse, and finally an acidulated rinse followed by forced drying. A visible coating is formed which offers good adhesion for

paint coatings. The processes may be carried out in dip tanks or by spraying in special compartments. The latter method is often preferred because of its greater speed and effectiveness. It is also better adapted to streamlined operation, since the parts to be treated can be placed on a chain conveyor and quickly carried through the entire cycle; in most cases 30 to 60 seconds is sufficient time for each stage of the process. While still on the conveyor, the parts proceed to the paint spray booth for painting.

Previous mention was made that it is sometimes desirable to intentionally increase the natural oxide film on an aluminum surface. This is accomplished by immersing the aluminum in a solution of chromic or sulphuric acid and passing an electric current through the cell, using the aluminum as the anode and the vessel containing the electrolyte as the cathode. This form of treatment is referred to as an "anodic treatment." Its use involves considerable equipment and it is also quite expensive.

One important thing to remember is that, regardless of the cleaning method employed, the surface of the aluminum must be thoroughly dry before paint is applied. Aluminum alloy castings should always be dried by heating. The surface also should be free from oil or grease and, in this connection, a minimum amount of handling is essential.

The type of surface preparation to be used is determined by the character of the metal, the type of the completed structure, and the conditions to which it will be exposed in service. Surfaces, including joints, which will be concealed in the completed structure should receive extra attention; these parts can be effectively protected by the application of a primer paint containing zinc chromate.

Action Recommended

Acceptance as information.

A.A.R. SIGNAL SECTION SPECIFICATION 259-52.

ALUMINUM PAINT (READY-MIXED)

1. *Purpose.*

(a) This specification is for the purpose of providing for a ready-mixed aluminum paint applicable for use on metal and masonry surfaces. It sets forth specific detail requirements representing modern signal practice recommended for the painting of new installations and for the repainting of existing installations when general renewal or repainting becomes desirable.

2. *Specifications.*

(a) Specifications referred to in the body of this specification form an essential part hereof.

3. *Tender.*

(a) The tender shall be for a product meeting the requirements of this specification in its entirety.

4. *Purchaser's order requirements.*

(a) The following additional requirements will be shown on the Purchaser's order:

1. Size and kind of containers.
2. Inspection and tests as required.
3. Alternate requisites as required.

5. *Alternates.*

(a) The provisions contained in the alternate requisites section of this specification form a part hereof only when substituted by Purchaser's order for the provisions contained in this specification.

6. *Material and workmanship.*

(a) Material and workmanship shall be first-class in every respect.

7. *Requirements.*

(a) General.

1. The paint shall be made by mixing aluminum pigment with a suitable vehicle.
2. The paint shall be suitable for brush or spray application.
3. The paint shall be of brushing consistency in the packaged condition and shall be such that when thinned in accordance with the recommendation of the Manufacturer of the paint, it shall be suitable for spraying. *R-7-a-3.

* Alternate requisites section.

7. Requirements.—Continued.

(b) Pigment.

1. The pigment shall consist of commercially pure aluminum in the form of fine flakes uniformly dispersed in mineral spirits to form a paste which shall be in accordance with the requirements of Federal Specification TT-A-468a, Type II, Class B, dated October 7, 1949. *R-7-b-1.

(c) Vehicle.

1. The vehicle shall consist of a phenolic resin base varnish of the long oil type and shall conform to the following requirements (*R-7-c-1):

(a) Phenolic resin content: 100 per cent (based on solids content).

(b) Oil: Shall be a suitable vegetable drying oil as is necessary to meet the requirements of this specification.

(c) Thinner: Shall be free from toxic hydrocarbons, such as benzol or chlorinated hydrocarbons.

(d) Driers: The vehicle shall be free from lead, manganese, calcium or zinc driers.

(e) Rosin or rosin derivatives content: None.

(f) Clarity: Clear, transparent, free from sediment and suspended matter when examined by transmitted light.

(g) Viscosity: Between 0.65 and 1.25 poises at 77 deg. F., corresponding to Tubes B to E of the Gardner-Holdt Air Bubble Viscometer.

(h) Flash point: Not less than 86 deg. F. in a closed cup tester.

(i) Non-volatile matter: Not less than 50 per cent, by weight, of non-volatile oils and resins.

(j) Elasticity and toughness: Shall pass a 100 per cent Kauri Reduction Test.

(k) Skinning: None after 48 hours in a three-fourths filled, tightly closed container.

(l) Gas and draft tests: Shall pass satisfactorily.

(m) Water immersion resistance: Flow out films on No. 28 gage tin plate panels, air-dried 72 hours, shall withstand immersion in cold water for 96 hours and in hot water (167 deg. F.) for 6 hours without whitening, dulling, checking, blistering or showing other serious defect.

(n) Alkali and acid immersion resistance: Films applied to test tubes (dimensions 6 in. by 1 in.) by immersion in varnish to a depth of 4 in. and dried in an inverted position for 72 hours shall show no whitening, dulling, or visible attack when immersed to a depth of 2 inches in a 5 per cent solution of sodium hydroxide for 6 hours (at 68 deg. F.) and (a separate similar film) in a

* Alternate requisites section.

7. *Requirements.*—Continued.

4 per cent solution of acetic acid for 24 hours (at 68 deg. F.).

(o) Gasoline immersion resistance: A flow out film on a No. 28 gage tin plate panel, air-dried 48 hours, shall be immersed in straight run gasoline for 48 hours. After subsequent air drying for 2 hours, the film shall show no whitening, dulling, or visible attack.

(d) Composition.

1. The paint shall meet the following requirements as to composition:

(a) Pigment (aluminum pigment flakes).

14 per cent of total weight of paint, minimum.

Total impurities (mica, filler and other adulterants): None.

Aluminum flakes retained on No. 325 mesh sieve: 1 per cent of total weight of pigment, maximum.

(b) Vehicle.

86 per cent of total weight of paint, maximum.

Non-volatile matter: 46 per cent of total weight of vehicle, minimum.

Volatile thinner: 54 per cent of total weight of vehicle, maximum.

(c) Paint.

8 lbs. per gallon, minimum.

(e) Packaging properties.

1. The paint, as received, shall show no objectionable settling and the pigment shall be readily dispersed by moderate stirring. The resulting paint shall be smooth and uniform in appearance, free from skins or coarse particles.

(f) Appearance.

1. The paint, when flowed on a clean glass panel, supported at an angle of 45 deg., and then allowed to dry, protected from all drafts, for 24 hours at room temperature (68 deg. to 86 deg. F.), shall produce a film comparable in smoothness, color, luster, and opacity to that of a similar film applied at the same time and in the same manner, using a standard comparison paint. The comparison standard shall be prepared by freshly mixing four ounces of aluminum paste meeting Federal Specification TT-A-468a, Type II, Class B, with one pint of phenolic resin base varnish vehicle meeting the requirements of section 7-c-1 of this specification.

(g) Skinning.

1. None, after 48 hours in a three-fourths filled, tightly closed container.

(h) Leafing.

1. Shall show a minimum leaf of 40 per cent.

7. *Requirements.*—Continued.(i) *Stability.*

1. After storage in a full, tightly closed container, at room temperature for 30 days, the paint shall show no skinning, thickening, curdling, jelling or settling of pigment that cannot be easily dispersed by moderate stirring and shall also pass the requirements for leafing as specified in section 7-h-1.

2. After 30 days storage, the filled container shall show no gas pressure.

(j) *Moisture content.*

1. The paint, when received, shall contain not more than 0.1 per cent of water by weight.

(k) *Drying time.*

1. When applied to a metal panel and allowed to air-dry in a vertical position, the paint shall set-to-touch in not less than 1 hour nor more than 4 hours at 86 deg. F. and shall dry hard and tough within 24 hours at 86 deg. F.

(l) *Viscosity.*

1. The paint, when received in brushing consistency, shall show a viscosity of between 30 and 45 seconds as determined by a No. 4 Ford Cup at 77 deg. F.

(m) *Elasticity and toughness.*

1. The paint shall pass a 100 per cent Kauri Reduction Test at 77 deg. F., based on vehicle solids (not paint solids). The bent panel shall be examined by a 10X glass to determine cracking of film.

8. *Application.*

(a) Application of aluminum paint (ready-mixed) shall be in accordance with Specification 120, Manual Part 110.

9. *Tests.*

(a) Tests may be made at point of production, or on samples submitted and may also be made at destination.

(b) Manufacturer shall give the Purchaser sufficient notice of time when the material or product will be ready for testing.

(c) Manufacturer shall provide, at point of production, apparatus and labor for making required tests under supervision of the Purchaser.

(d) If tests are to be made at point of production, it shall be so stated on Purchaser's order. The Purchaser shall indicate which of the tests herein specified are to be made and what portion of the material or product shall be tested.

(e) Tests required in sections 7-c to 7-m, inclusive, except as otherwise specified, shall be conducted in accordance with the methods described in Federal Specification TT-P-141b, as follows:

9. Tests.—Continued.

Test for	Method of testing as shown in Fed. Spec. TT-P-141b
Driers.....	723.1
Rosin or rosin derivatives.....	503.1
Viscosity (vehicle).....	427.1
Flash point.....	429.1
Non-volatile matter.....	405.3
Elasticity and toughness (vehicle).....	415.1
Skinning.....	414.1
Gas test.....	416.1
Draft test.....	417.1
Water immersion resistance.....	601.1
Alkali and acid immersion resistance.....	601.1
Gasoline immersion resistance.....	601.1
Pigment content.....	402.1
Non-volatile vehicle content.....	405.3
Weight per gallon.....	401.1
Working properties.....	454.1
Leafing (10 minute examination).....	445.1
Stability.....	414.2
Moisture content.....	408.1
Drying time.....	406.2
Viscosity (paint).....	428.2
Elasticity and toughness (paint).....	415.1

10. Inspection.

(a) The product furnished under this specification may be accepted upon Manufacturer's certificates of guarantee insuring that it is in accordance with the specification. If on arrival at destination the product is found not to meet the requirements of the specification it may be rejected and the Manufacturer, upon request, shall advise the Purchaser what disposition is to be made of the rejected product. Manufacturer shall pay all freight charges.

11. Containers.

(a) Product will be furnished in 1 quart, 1 gallon and 5 gallon containers, or in drums, as specified by the Purchaser.

12. Packing.

(a) Product shall be so assembled or packed as to permit convenient handling and to protect against loss or damage during shipment.

13. Marking.

(a) Purchaser's order, requisition and package number, name of Consignor, and name and address of Consignee, shall be plainly marked on outside of packages and on tags attached to loose pieces.

13. *Marking.*—Continued.

(b) Detail list of loose pieces, packages and their contents shall be furnished for each shipment. Where carload shipments are made, routing and car identification shall be shown.

14. *Warranty.*

(a) Manufacturer shall warrant the product covered by this specification to be free from defects in material and workmanship under ordinary use and service, his obligation under this warranty being limited to manufacturing, at point of production, any part or parts to replace those which shall be found defective within 1 year after shipment to the Purchaser. This warranty shall not apply to any product which has been subjected to misuse, negligence or accident.

Alternate requisites.

R-7-a-3.

The paint shall be furnished in proper consistency for application by spraying.

R-7-b-1.

The pigment shall consist of finely divided aluminum powder, and shall meet the requirements for coarse particles and leafing of Federal Specification TT-A-468a, Type I, Class B, dated October 7, 1949.

R-7-c-1.

The vehicle shall consist ofand shall conform to the following requirements:

- (a)
- (b)
- (c)

Action Recommended

Acceptance for submission to letter ballot.

(Revision of A.A.R. Signal Section Specification 13-39)
A.A.R. SIGNAL SECTION SPECIFICATION 13-52.

HARD FIBRE

1. *Purpose.*

(a) This specification is for the purpose of providing for bone grade vulcanized fibre to be used as electrical insulation on rail joints, switch rods, gage plates, ball studs, pipe lines and similar fittings. It sets forth specific detail requirements representing modern signal practice recommended for new installations and for replacement on existing installations when general renewal or replacement becomes desirable.

2. *Requisites and specifications.*

(a) Requisites and specifications referred to in the body of this specification form an essential part hereof.

3. *Tender.*

(a) The tender shall be for a product meeting the requirements of this specification in its entirety.

4. *Purchaser's order requirements.*

(a) The following additional requirements will be shown on the Purchaser's order:

1. Specify if for fabrication of head and base pieces for insulated rail joints.
2. Inspection and tests as required.

5. *Material and workmanship.*

(a) Material and workmanship shall be first-class in every respect.

6. *Requirements.*

(a) Sheets, rods and tubes.

1. The fibre in the form of sheets, rods and tubes, shall be in accordance with A.S.T.M. current Specification D 710, Bone Grade, except as follows:

(a) Density. Shall be not less than 1.35 grams per cu. cm.

(b) Compressive strength.

1. When sheet fibre is tested for compressive strength in accordance with method of test as

6. *Requirements.*—Continued.

described in section 7-a-1, the depth of depression shall not exceed the following values:

Specified thickness, in.	Mean depression, in.
$\frac{1}{8}$	0.023
$\frac{3}{16}$	0.028
$\frac{1}{4}$	0.036
$\frac{3}{8}$	0.050

2. In case of dispute, new test pieces shall be conditioned in accordance with A.S.T.M. current Specification D 619 and test repeated.

(c) Water absorption. When the fibre is tested in accordance with method of test as described in section 7-b-1, the increase in weight of sheet fibre due to water absorption shall not exceed 0.67 gram.

(d) Thickness tolerances. Thickness of sheet fibre for use in the fabrication of head and base pieces for insulated rail joints, where the angle bar follows the contour of and forms a bearing under the rail base, shall be within the following limits:

Specified thickness, in.	Maximum thickness, in.	Minimum thickness, in.
$\frac{1}{8}$ (0.125)	0.133	0.123
$\frac{3}{16}$ (0.187)	0.195	0.185

(b) Fabricated fibre parts.

1. Fabricated fibre parts for track insulation shall be in accordance with Requisites for Fabricated Fibre Parts for Track Insulation, Manual Part

7. *Methods of tests.*

(a) Compression test for sheet material.

1. A standard testing machine shall be used and the load applied through a metal tup $\frac{1}{2}$ in. by $\frac{1}{2}$ in. with corners rounded to $\frac{1}{4}$ in. radius, arranged in such manner as to insure an equal bearing of the test sample over the entire surface of the tup. A test piece 1 in. by 1 in. by the thickness shall be placed without conditioning under an initial load of 100 lbs. and the zero reading taken. A load of 5,000 lbs. shall then be applied. The depth of depression in inches shall be measured by the mean reading of two suitable measuring and indicating appliances mounted on the upper crushing head of machine, the samples being supported on the lower crushing head.

(b) Water absorption test for sheet material.

1. A test piece 1 in. by 1 in. by the thickness shall be weighed and placed in water at room temperature. It shall be removed from the water at the expiration of 6 hours, the

7. *Methods of tests.*—Continued.

excess moisture wiped off and the test piece weighed immediately. The increase in weight shall be an indication of the water absorption in grams.

8. *Inspection.*

(a) Purchaser may inspect the material or product at all stages of manufacture.

(b) Purchaser may inspect the completed product at point of production to determine that the requirements of this specification have been met.

(c) If product has not been accepted at point of production and if, upon arrival at destination, it does not meet the requirements of this specification, other than dimensional, it may be rejected, and the Manufacturer, upon request, shall advise the Purchaser what disposition is to be made of the rejected product. Manufacturer shall pay all freight charges.

(d) If Purchaser is to make inspection at point of production it shall be so stated on Purchaser's order.

9. *Tests.*

(a) Tests may be made at point of production, or on samples submitted, and may also be made at destination.

(b) Manufacturer shall give the Purchaser sufficient notice of time when the material or product will be ready for testing.

(c) Manufacturer shall provide, at point of production, apparatus and labor for making required tests under supervision of the Purchaser.

(d) If tests are to be made at point of production, it shall be so stated on Purchaser's order. The Purchaser shall indicate which of the tests herein specified are to be made and what portion of the material or product shall be tested.

(e) Testing methods and conditioning for test shall be in accordance with A.S.T.M. current Specification D 619 unless otherwise specified herein.

10. *Samples for tests.*

(a) Three samples shall be selected at random by the Purchaser or his representative from each lot, run or part thereof of 25 sheets of the same specified thickness or 500 fabricated pieces of the same specified thickness. Test pieces of the required size shall be sawed from each sample selected and shall be free from burrs. If any of the samples fail to meet the requirements of any of the specified tests, the tests shall be repeated on two additional samples selected at random from different pieces of the same lot. Failure of one or both of these samples to meet the requirements of the tests will be sufficient cause for rejection of the lot.

11. *Packing.*

(a) Product shall be so assembled or packed as to permit convenient handling and to protect against loss or damage during shipment.

12. *Marking.*

(a) Purchaser's order, requisition and package number, name of Consignor, and name and address of Consignee, shall be plainly marked on outside of packages and on tags attached to loose pieces.

(b) Detail list of loose pieces, packages and their contents shall be furnished for each shipment. Where carload shipments are made, routing and car identification shall be shown.

13. *Warranty.*

(a) Manufacturer shall warrant the product covered by this specification to be free from defects in material and workmanship under ordinary use and service, his obligation under this warranty being limited to manufacturing, at point of production, any part or parts to replace those which shall be found defective within 90 days after shipment to the Purchaser. This warranty shall not apply to any product which shall have been repaired or altered in any way by anyone other than the Manufacturer thereof, so as to affect, in the Manufacturer's judgment, its proper functioning or reliability, or which has been subjected to misuse, negligence or accident.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Specification 13-39—Hard Fibre, Manual Part 58.

A.A.R. SIGNAL SECTION REQUISITES.

FABRICATED FIBRE PARTS FOR TRACK INSULATION

1952

1. *Purpose.*

(a) These requisites are for the purpose of setting forth the recommended general requirements and permissible variations in dimensions and contours in the fabrication of finished fibre parts for track insulation. They set forth specific detail requirements representing modern signal practice recommended for new installations and for replacement of existing installations when general renewal or replacement becomes desirable.

2. *General.*

(a) All fabricated parts shall be of hard fibre meeting the requirements of Specification 13, Manual Part 58.

(b) Fabricated parts, except head pieces, base pieces and bushings, shall have tolerances of thickness in accordance with A.S.T.M. current Specification D 710.

(c) Edges shall be free from burrs and other defects.

3. *Head and base pieces.*

(a) Head and base pieces for use in insulated rail joints where the angle bar follows the contour of and forms a bearing under rail base, shall meet the following requirements:

1. Thickness of head and base pieces shall be within the following limits:

Specified thickness, in.	Maximum thickness, in.	Minimum thickness, in.
$\frac{1}{8}$ (0.125)	0.133	0.123
$\frac{3}{16}$ (0.187)	0.195	0.185

2. *Base pieces (Fig. 1).*

(a) Radius of bend at crotch (detail R, Fig. 1) at time of shipment shall be as shown on Purchaser's drawing plus $\frac{1}{32}$ in. minus zero.

(b) Angle of bend (detail B, Fig. 1) at time of shipment shall be not greater than 25 deg.

(c) Length of bottom or base leg (detail C, Fig. 1) and of vertical top-extension (detail D, Fig. 1) shall be as shown on Purchaser's drawing plus or minus $\frac{1}{8}$ in.

(d) Over-all length shall be as shown on Purchaser's drawing plus or minus $\frac{1}{8}$ in.

3. *Head pieces, non-armored (Fig. 2).*

(a) Angle of bend (detail A, Fig. 2) at time of shipment shall be as shown on Purchaser's drawing plus 4 deg. minus 8 deg.

3. *Head and base pieces.*—Continued.

(b) Length of each leg (details B and C, Fig. 2) shall be as shown on Purchaser's drawing plus or minus $\frac{1}{16}$ in.

(c) Over-all length shall be as shown on Purchaser's drawing plus or minus $\frac{1}{8}$ in.

(d) Location of bolt apertures shall be:

1. Longitudinally as shown on Purchaser's drawing plus or minus $\frac{1}{16}$ in.

2. Vertically as shown on Purchaser's drawing plus $\frac{1}{8}$ in. minus zero.

4. *Head pieces, armored.*

(a) Angles of bends and lengths of angular surfaces shall be such as to accurately and snugly fit the contour of joint bar.

(b) Over-all length shall be as shown on Purchaser's drawing plus or minus $\frac{1}{16}$ in.

(c) Location of bolt apertures shall be:

1. Longitudinally as shown on Purchaser's drawing plus or minus $\frac{1}{32}$ in.

2. Vertically as shown on Purchaser's drawing plus or minus $\frac{1}{16}$ in.

(d) Diameter of bolt apertures shall be as shown on Purchaser's drawing plus $\frac{1}{32}$ in. minus zero.

4. *Bushings.*

(a) Inside and outside diameters shall be as shown on Purchaser's drawing plus or minus 0.0075 in.

(b) Length shall be as shown on Purchaser's drawing plus or minus $\frac{1}{32}$ in.

(c) Variations in wall thickness due to eccentricity shall not exceed 0.015 in.

5. *Washer plates for insulated rail joints and flat pieces for switch rods, gage plates and pipe insulation.*

(a) Over-all length and width shall be as shown on Purchaser's drawing plus or minus $\frac{1}{16}$ in.

(b) Location of holes shall be as shown on Purchaser's drawing plus or minus $\frac{1}{32}$ in.

(c) Diameter of holes shall be as shown on Purchaser's drawing plus $\frac{1}{32}$ in. minus zero.

6. *End posts.*

(a) End posts for non-armored insulated rail joints shall not, in contour, exceed the contour of the proper rail section at any point but may come within the rail section contour by not more than $\frac{1}{32}$ in. except at the top of rail where end post may come within the rail section by not more than $\frac{1}{8}$ in., and except at sides of head, where end post may come within the rail section by not more than $\frac{1}{16}$ in.

6. *End posts.*—Continued.

(b) End posts for armored insulated rail joints shall be in accordance with Requisite 6-a in all respects except that they shall extend beyond the contour of rail section at underside of head and upper portion of web only, by not less than $\frac{1}{16}$ in. and by not more than $\frac{3}{32}$ in.

7. *Waterproofing.*

(a) An approved waterproofing treatment shall be given to all parts.

8. *Marking.*

(a) Each piece of fibre, except bushing, shall be clearly marked with Manufacturer's name or trade-mark, and in case of insulated rail joint parts, the rail section for which it is designed.

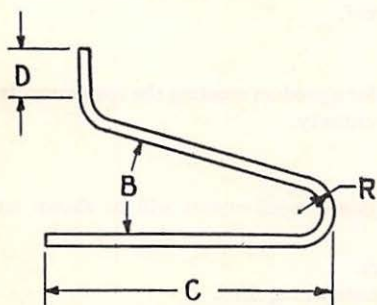


Fig. 1

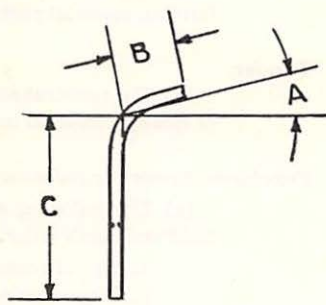


Fig. 2

Action Recommended

Acceptance for submission to letter ballot.

(Revision of A.A.R. Signal Section Specification 77-41)
A.A.R. SIGNAL SECTION SPECIFICATION 77-52.

IMPEDANCE BOND COMPOUND

1. *Purpose.*

(a) This specification is for the purpose of providing for a compound for use in impedance bonds as an insulating and a cooling medium. It sets forth specific detail requirements representing modern signal practice recommended for new installations and for replacement on existing installations when general renewal or replacement becomes desirable.

2. *Specifications.*

(a) Specifications referred to in the body of this specification form an essential part hereof.

3. *Tender.*

(a) The tender shall be for a product meeting the requirements of this specification in its entirety.

4. *Purchaser's order requirements.*

(a) The following additional requirements will be shown on the Purchaser's order:

1. Size of containers.
2. Inspection and tests as required.

5. *Material and workmanship.*

(a) Material and workmanship shall be first-class in every respect.

6. *Requirements.*

(a) The product shall result from the distillation of petroleum and shall be free from crystalline wax, water, acid, alkali, and other impurities which will injuriously affect its insulating properties.

(b) The product shall be in accordance with the following requirements:

1. Specific gravity: between 27 deg. Baume (0.891) and 30 deg. Baume (0.875).
2. Flash point: 375 deg. F. minimum.
3. Melting point: between 120 and 135 deg. F.
4. Free water: none.
5. Total acid number: neutralization value 0.10 maximum.
6. Corrosion of copper: none.
7. Dielectric strength: 15 kv. minimum at 150 deg. F.

7. Inspection.

(a) Purchaser may inspect the material or product at all stages of manufacture.

(b) Purchaser may inspect the completed product to determine that the requirements of this specification have been met.

(c) If product has not been accepted at point of production and if, upon arrival at destination, it does not meet the requirements of this specification, it may be rejected, and the Manufacturer, upon request, shall advise the Purchaser what disposition is to be made of the rejected product. Manufacturer shall pay all freight charges.

(d) If Purchaser is to make inspection at point of production it shall be so stated on Purchaser's order.

8. Tests.

(a) Tests may be made at point of production, or on samples submitted, and may also be made at destination.

(b) Manufacturer shall give the Purchaser sufficient notice of time when material or product will be ready for testing.

(c) Manufacturer shall provide, at point of production, apparatus and labor for making required tests under supervision of the Purchaser.

(d) If tests are to be made at point of production, it shall be so stated on Purchaser's order. The Purchaser shall indicate which of the tests herein specified are to be made and what portion of the material or product shall be tested.

(e) All tests shall be made in accordance with current A.S.T.M. methods:

1. Sampling—A.S.T.M. D 270.
2. Specific gravity—A.S.T.M. D 70.
3. Flash point—A.S.T.M. D 92.
4. Melting point—A.S.T.M. D 127.
5. Water content—A.S.T.M. D 95.
6. Neutralization value—A.S.T.M. D 974 or D 664.
7. Corrosion—A.S.T.M. D 130.
8. Dielectric strength—A.S.T.M. D 176.

9. Containers.

(a) The product shall be furnished in non-returnable metal containers.

(b) Purchaser shall specify size of containers.

10. Packing.

(a) Product shall be so assembled or packed as to permit convenient handling and to protect against loss or damage during shipment.

11. *Marking.*

(a) Purchaser's order, requisition and package number, name of Consignor, and name and address of Consignee, shall be plainly marked on outside of each package.

(b) Detail list of packages and their contents shall be furnished for each shipment. Where carload shipments are made, routing and car identification shall be shown.

12. *Warranty.*

(a) Manufacturer shall warrant the product covered by this specification to be free from defects in material and workmanship under ordinary use and service, his obligation under this warranty being limited to manufacturing, at point of production, any part or parts to replace those which shall be found defective within 90 days after shipment to the Purchaser. This warranty shall not apply to any product which has been subjected to misuse, negligence or accident.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Specification 77-41—Insulating Compound for Use in Impedance Bonds, Manual Part 111.

(Revision of Specifications for Various Types of Non-Ferrous Metals and Alloys)

SPECIFICATIONS FOR VARIOUS TYPES OF
NON-FERROUS METALS AND ALLOYS

1952

The recommended specifications for various types of non-ferrous metals and alloys shall be the current specifications of the American Society for Testing Materials, for application as follows:

1. Binding posts and screws with cold upset heads and rolled threads:
 - (a) B 98—Copper-Silicon Alloy Rods, Bars and Shapes, Alloy B, extra-hard, bolt temper.
 - (b) B 164—Nickel-Copper Alloy Rods and Bars, Class A, cold-drawn.
2. Binding posts and screws, machine-cut:
 - (a) B 98—Copper-Silicon Alloy Rods, Bars and Shapes, Alloy D, hard temper.
 - (b) B 140—Leaded Red Brass (Hardware Bronze) Rods, Bars and Shapes, Alloy B, half-hard temper.
 - (c) B 164—Nickel-Copper Alloy Rods and Bars, Class B, cold-drawn.
3. Nuts for binding posts and general purposes:
 - (a) B 16—Free-Cutting Brass Rod and Bar for Use in Screw Machines, half-hard temper.
4. Machine-cut screws other than for use as binding posts:
 - (a) B 16—Free-Cutting Brass Rod and Bar for Use in Screw Machines, half-hard temper. (Not to be used for securing vital parts.)
 - (b) B 98—Copper-Silicon Alloy Rods, Bars and Shapes, Alloy D, hard temper.
 - (c) B 139—Phosphor Bronze Rods, Bars and Shapes, alloy as required. (For screws, shafts, bushings, trunnions and other structural parts.)
 - (d) B 140—Leaded Red Brass (Hardware Bronze) Rods, Bars and Shapes, Alloy B, half-hard temper.
 - (e) B 164—Nickel-Copper Alloy Rods and Bars, Class B, cold-drawn.
5. Commercial screws with cold upset head and rolled threads:
 - (a) B 134—Brass Wire, Alloy No. 7, eighth hard temper.
6. Washers for use on binding posts:
 - (a) B 152—Copper Sheet, Strip, and Plate, Type ETP cold-rolled hard temper.

7. Structural parts and general purpose washers:

- (a) B 16—Free-Cutting Brass Rod and Bar for Use in Screw Machines, half-hard temper. (Not to be used for securing vital parts.)
- (b) B 36—Brass Plate, Sheet and Strip, alloy number and temper as required.
- (c) B 97—Copper-Silicon Alloy Plate, Sheet and Strip for General Purposes, alloy and temper as required.
- (d) B 98—Copper-Silicon Alloy Rods, Bars, and Shapes, Alloy D, hard temper.
- (e) B 103—Phosphor Bronze Plate, Sheet and Strip, alloy and temper as required.
- (f) B 122—Copper-Nickel-Zinc and Copper-Nickel Alloy Plate, Sheet and Strip, alloy number and temper as required.
- (g) B 127—Nickel-Copper Alloy Plate, Sheet, and Strip, finish and temper as required.
- (h) B 135—Seamless Brass Tubes, alloy and temper as required.
- (i) B 139—Phosphor Bronze Rods, Bars and Shapes, alloy as required. (For screws, shafts, bushings, trunnions and other structural parts.)
- (j) B 140—Leaded Red Brass (Hardware Bronze) Bars and Shapes, Alloy B, half-hard temper.
- (k) B 152—Copper Sheet, Strip, and Plate, type and temper as required.
- (l) B 164—Nickel-Copper Alloy Rods and Bars, Class B, cold-drawn.
- (m) B 187—Copper Bus Bars, Rods and Shapes.
- (n) B 194—Beryllium Copper Alloy Plate, Sheet and Strip, temper as required.
- (o) B 196—Beryllium Copper Alloy Rod and Bar, temper as required.
- (p) B 209—Aluminum and Aluminum Alloy Sheet and Plate, alloy number and temper as required.
- (q) B 211—Aluminum and Aluminum-Alloy Bars, Rods and Wire, alloy number and temper as required.

8. Spring contacts and contact springs:

- (a) B 103—Phosphor Bronze Plate, Sheet and Strip, alloy and temper as required.
- (b) B 122—Copper-Nickel-Zinc and Copper-Nickel Alloy Plate, Sheet and Strip, alloy number and temper as required.
- (c) B 162—Nickel Plate, Sheet and Strip, temper as required.
- (d) B 194—Beryllium Copper Alloy Plate, Sheet and Strip, temper as required.

9. Connectors:

- (a) B 152—Copper Sheet, Strip and Plate, Type ETP, temper as required.

10. Coiled springs:

- (a) B 159—Phosphor Bronze Wire, alloy and temper as required.
- (b) B 197—Beryllium Copper Alloy Wire.

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Committee VII—Materials Research

11. Die castings:

- (a) B 85—Aluminum Base Alloy Die Castings, alloy as required.
- (b) B 86—Zinc Base Alloy Die Castings, alloy number as required.
- (c) B 176—Copper Base (Brass) Alloy Die Castings, alloy as required.

12. Sand castings:

- (a) B 26—Aluminum Base Alloy Sand Castings, alloy and treatment as required.
- (b) Specifications for various Cast Copper Base Alloys can be found in Standard Classification for Cast Copper Base Alloys listed under "Explanatory Note" in B 119.

13. Forgings (for hot forged parts):

- (a) B 124—Copper and Copper Base Alloy Forging Rods, Bars and Shapes, alloy as required.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Specifications for Various Types of Non-Ferrous Metals and Alloys,
Manual Part 220.

(Revision of A.A.R. Signal Section Specification 217-46)
A.A.R. SIGNAL SECTION SPECIFICATION 217-52.

IMPEDANCE BOND OIL

1. *Purpose.*

(a) This specification is for the purpose of providing for an oil for use in impedance bonds as an insulating and a cooling medium. It sets forth specific detail requirements representing modern signal practice recommended for new installations and for replacement on existing installations when general renewal or replacement becomes desirable.

2. *Specifications.*

(a) Specifications referred to in the body of this specification form an essential part hereof.

3. *Tender.*

(a) The tender shall be for a product meeting the requirements of this specification in its entirety.

4. *Purchaser's order requirements.*

(a) The following additional requirements will be shown on the Purchaser's order:

1. Size of containers.
2. Inspection and tests as required.

5. *Material and workmanship.*

(a) Material and workmanship shall be first-class in every respect.

6. *Requirements.*

(a) The product shall be pure mineral oil obtained by fractional distillation of petroleum and shall not contain any substance which will injuriously affect its insulating properties.

(b) The product shall be in accordance with the following requirements:

1. Color: A.S.T.M. No. 3 N.P.A. or lighter, transparent (lemon pale).
2. Flash point: 340 deg. F. minimum.
3. Fire point: 390 deg. F. minimum.
4. Pour point: 5 deg. F. maximum.
5. Viscosity: S.U. at 100 deg. F., 270-375 seconds.
6. Total acid number: neutralization value 0.03 maximum.
7. Mineral acids: (water soluble) nil.
8. Alkali: nil.

6. Requirements—Continued.

9. Free sulphur: nil.
10. Inorganic chlorides and sulphates: nil.
11. Free water: none.
12. Dielectric strength: 10 kv. minimum.

7. Inspection.

(a) Purchaser may inspect the material or product at all stages of manufacture.

(b) Purchaser may inspect the completed product to determine that the requirements of this specification have been met.

(c) If product has not been accepted at point of production and if, upon arrival at destination, it does not meet the requirements of this specification, it may be rejected, and the Manufacturer, upon request, shall advise the Purchaser what disposition is to be made of the rejected product. Manufacturer shall pay all freight charges.

(d) If Purchaser is to make inspection at point of production it shall be so stated on Purchaser's order.

8. Tests.

(a) Tests may be made at point of production, or on samples submitted, and may also be made at destination.

(b) Manufacturer shall give the Purchaser sufficient notice of time when the material or product will be ready for testing.

(c) Manufacturer shall provide, at point of production, apparatus and labor for making required tests under supervision of the Purchaser.

(d) If tests are to be made at point of production, it shall be so stated on Purchaser's order. The Purchaser shall indicate which of the tests herein specified are to be made and what portion of the material or product shall be tested.

(e) All tests shall be made in accordance with current A.S.T.M. methods:

1. Sampling—A.S.T.M. D 923.
2. Color—A.S.T.M. D 155.
3. Flash point and fire point—A.S.T.M. D 92.
4. Pour point—A.S.T.M. D 97.
5. Viscosity—A.S.T.M. D 88.
6. Neutralization value—A.S.T.M. D 974 or D 664.
7. Mineral acid—A.S.T.M. D 117.
8. Alkali—A.S.T.M. D 974 or D 664.
9. Free sulphur—A.S.T.M. D 989.
10. Inorganic chlorides and sulphates—A.S.T.M. D 878.
11. Water content—A.S.T.M. D 95.
12. Dielectric strength—A.S.T.M. D 877.

9. *Containers.*

(a) The product shall be furnished in clean dry containers. Except when furnished in drums, containers shall be provided with a suitable replaceable pour opening cap.

(b) Purchaser shall specify size of containers.

10. *Packing.*

(a) Product shall be so assembled or packed as to permit convenient handling and to protect against loss or damage during shipment.

11. *Marking.*

(a) Purchaser's order, requisition and package number, name of Consignor, and name and address of Consignee, shall be plainly marked on outside of package.

(b) Detail list of packages and their contents shall be furnished for each shipment. Where carload shipments are made, routing and car identification shall be shown.

12. *Warranty.*

(a) Manufacturer shall warrant the product covered by this specification to be free from defects in material and workmanship under ordinary use and service, his obligation under this warranty being limited to manufacturing, at point of production, any part or parts to replace those which shall be found defective within 60 days after shipment to the Purchaser. This warranty shall not apply to any product which has been subjected to misuse, negligence or accident.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter,
in the Manual.

Subject-matter to be Superseded

Specification 217-46—Insulating Oil for Use in Impedance Bonds,
Manual Part 222.

FIELD USES OF RUST PREVENTIVES

(Exclusive of Paint)

The results obtained from the use of various rust preventives depend to a great extent upon local conditions and methods of application, consequently specific recommendations cannot be made regarding the use of any particular product.

Table I indicates classification numbers which have been assigned to various field uses of rust preventives in order to simplify the preparation of Table II.

Table II indicates actual uses reported by some railroads and uses recommended by manufacturers. In this table, reference to various field uses is made by means of the classification numbers given in Table I.

TABLE I

Classification of Field Uses

Classification number	Uses
1	Storage for limited periods.
2	Rail braces and gage plates.
3	Insulated rail joints.
4	Track bond and rail connections.
5	Pipe, rod and bolt threads.
6	Inaccessible portions. (a) Anchor bolts. (b) Signal assembly fastenings. (c) Switch machines. (d) Retarder parts.
7	Metal cases and similar surfaces not accessible for painting.
8	Inside of signal masts.
9	Unpainted surfaces of interlocking machine and parts.

TABLE II

Actual and Manufacturers' Recommended Field Uses

Product	Manufacturer	Actual railroad use reported	Uses recommended by manufacturers
A.A.R. cold compounds Sig. Sec. Spec. 188	Maloney Oil & Mfg. Co., New York, N. Y.	6 (a), 7	
Black oil	Various	1, 2, 3, 5	
Car oil	Various	1	
Chipman Chem. Co. lubricant	Chipman Chem. Co., Chicago, Ill.	2	
Crank case oil	Various	1, 5	

TABLE II—Continued

Product	Manufacturer	Actual railroad use reported	Uses recom- mended by manu- facturers
Duxseal	Johns-Manville Corp., New York, N. Y.	6 (a), 6 (c), 6 (d), 7	
Fibrate water- proofing compound	Sanger Production Co., Rochester, N. Y.	7	
Graphol oil	Graphol Products Co., Brooklyn, N. Y.	9	
Leadolene	Brooks Oil Co., Cleveland, Ohio	2, 3, 4	
Missouri Pacific Spec. R-201	Various	3	
NO-OX-ID "A Special"	Dearborn Chem. Co., Chicago, Ill.	1, 2, 3, 4, 6 (a), 6 (b), 6 (c), 6 (d), 7, 9	1, 2, 3, 4, 5, 6 (a), 6 (b), 6 (c), 6 (d), 7, 8, 9
NO-OX-ID 406	Dearborn Chem. Co., Chicago, Ill.		5, 6 (d), 7, 8, 9
Nox-Rust 200	Nox-Rust Chem. Corp., Chicago, Ill.		1, 2, 4, 5, 9
Nox-Rust 366	Nox-Rust Chem. Corp., Chicago, Ill.		1
Nox-Rust 488	Nox-Rust Chem. Corp., Chicago, Ill.		2, 6 (c), 6 (d)
Oxylin	Ball Chem. Co., Pittsburgh, Pa.	6 (a), 6 (c), 6 (d), 7	
Penetrol	The Flood Co., Hudson, Ohio		1, 3, 5, 6 (b), 6 (c), 6 (d), 7, 8
Preservative oil	Specialty Gulf Refining Co., No address given	2, 3	
Protect coat	Nox-Rust Chem. Corp., Chicago, Ill.		6 (a), 6 (b), 7
Rust preventive	Ball Chem. Co., Pittsburgh, Pa.	1, 9	
Rust proof compound LB	Texas Oil Co., New York, N. Y.		1, 2, 3, 4, 5, 6 (a), 6 (b), 6 (c), 6 (d), 7, 9
Semaphore oil	Various	9	
Slushing oil #75	Houghton Co., Philadelphia, Pa.	5, 9	
Slushing oil #75	Nox-Rust Chem. Corp., Chicago, Ill.	1, 6 (d)	
S/V #908 Flushing	Socony-Vacuum New York, N. Y.	1	

TABLE II—Continued

Product	Manufacturer	Actual railroad use reported	Uses recom- mended by manu- facturers
S/V Product 2305	Socony-Vacuum, New York, N. Y.		3
S/V Sova-Kote 201	Socony-Vacuum, New York, N. Y.		9
S/V Sova-Kote 302	Socony-Vacuum, New York, N. Y.		2, 4, 5, 6 (a), 9
S/V Sova-Kote 601	Socony-Vacuum, New York, N. Y.		1, 2, 4, 5, 6 (b), 6 (c), 6 (d), 7, 8 9
Tectyl 500-11	Freedom-Valvoline Oil Co., Freedom, Pa.		
Tectyl 502-C	Freedom-Valvoline Oil Co., Freedom, Pa.		6 (a), 6 (b), 6 (c), 6 (d)
Texaco #45	Texas Oil Co., New York, N. Y.	5	
Texaco #55	Texas Oil Co., New York, N. Y.	2, 3, 4, 5	
Texaco #965 grease	Texas Oil Co., New York, N. Y.	6 (c)	
Texaco home lubricant	Texas Oil Co., New York, N. Y.	9	
Texaco metal preservative	Texas Oil Co., New York, N. Y.	2, 3, 4	
Texaco rust compound	Texas Oil Co., New York, N. Y.	1	
Track oil NYCS Spec. 1206A, Class 21	Various	1, 3	
X-Rust 400-C	Freedom-Valvoline Oil Co., Freedom, Pa.		7, 8
X-Rust 450	Freedom-Valvoline Oil Co., Freedom, Pa.		2, 3, 4, 9
X-Rust 469-A	Freedom-Valvoline Oil Co., Freedom, Pa.		1, 5
X-Rust 483	Freedom-Valvoline Oil Co., Freedom, Pa.		2, 4

Action Recommended

Acceptance as information.

USE OF STAINLESS STEEL GUY AND MESSENGER STRAND

Supplementing previous reports presented as information at the 1948 and 1949 Annual Meetings*, further investigation develops the following:

A recent check of the use of stainless steel guy and messenger strand revealed that 18 railroads are now using or are considering its use. Three railroads reported stainless steel strand in use for special purposes in the amounts of 155,000 feet, 100,000 feet and 50,000 feet, respectively, and 15 railroads report having various amounts from 1,000 to 5,500 feet each for trial.

Information available indicates that stainless steel is satisfactory for use as guy and messenger strand. It may be particularly desirable at locations where corrosive conditions are present.

Stainless steel strand is preformed for safe handling in the field and can be formed around a mandrel having a diameter eight times that of the strand without fracture or injury.

Stainless steel or bronze clamp and splice fittings are being manufactured and should be used for securing stainless steel guy and messenger strand.

The manufacturer recommends the use of stainless steel A.I.S.I. Type 301 which contains 16 to 18 per cent chromium, 6 to 8 per cent nickel, and 0.08 to 0.20 per cent carbon in the making of guy and messenger strands. This type is preferred because of its characteristics, which are as follows:

1. It work hardens very rapidly in cold drawing which makes it possible to get extremely high tensile strength—235,000 p.s.i. minimum.
2. When hard-drawn it is only slightly magnetic.
3. When stranded it has a relatively low modulus of elasticity.
4. It has excellent corrosion-resisting qualities with high yield and fatigue strengths.

A comparison of the breaking strength of stainless steel, copper-covered steel, galvanized steel, and bronze guy and messenger strand is shown in the following tabulations:

Stainless Steel Guy and Messenger Strand—
Information Submitted by Manufacturer

Size, inches	Number of strands	Minimum breaking strength, lbs.
$\frac{7}{32}$	7	6,300
$\frac{1}{4}$	7	8,500
$\frac{9}{32}$	7	10,700
$\frac{5}{16}$	7	13,200
$\frac{3}{8}$	7	18,000
$\frac{7}{16}$	7	26,000
$\frac{1}{2}$	7	33,700

* A.A.R. Signal Section 1947 Proceedings, Vol. XLV, pp. 263 and 422, and A.A.R. Signal Section 1948 Proceedings, Vol. XLVI, pp. 346 and 470.

Copper-Covered Steel Guy and Messenger Strand—
Per A.A.R. Signal Section Specification 173, Manual Part 69

Size, inches	Number of strands	Minimum breaking load, lbs.	
		High strength	Extra high strength
$\frac{5}{16}$	7	7,750	9,200
$\frac{11}{32}$	7	9,320	11,280
$\frac{3}{8}$	7	11,340	13,800
$\frac{7}{16}$	7	13,860	16,820
$\frac{1}{2}$	7	16,880	20,410

Galvanized Steel Guy and Messenger Strand—
Per A.A.R. Communications Section Specification 1-A-17

Size, inches	Number of strands	Minimum breaking strength, lbs.
$\frac{3}{32}$	7	4,600
$\frac{5}{16}$	7	7,000
$\frac{3}{8}$	7	11,600
$\frac{7}{16}$	7	18,600

Bronze Guy and Messenger Strand—
Per A.A.R. Communications Section Specification 1-A-53

Size, inches	Number of strands	Minimum breaking strength, lbs.
$\frac{5}{16}$	7	7,000
$\frac{3}{8}$	7	10,000
$\frac{15}{32}$	7	16,000

Action Recommended

Acceptance as information.

(Revision of Specification for Signal Colors Exclusive of Signal Glasses)

**SPECIFICATION FOR SIGNAL COLORS EXCLUSIVE OF
SIGNAL GLASSES**

1952

The following colors are recommended for switch targets, interlocking machine levers, semaphore signal blades and similar equipment:

Red —Color No. 1105, Federal Specification TT-C-595
Yellow—Color No. 1310, Federal Specification TT-C-595
Blue —Color No. 1520, Federal Specification TT-C-595
White —Color No. 1755, Federal Specification TT-C-595
Black —Color No. 1775, Federal Specification TT-C-595
Green —Color No. 1445, Federal Specification TT-C-595

Note.—Federal Specification TT-C-595, "Colors; (for) Ready-Mixed Paints" is for sale by the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D. C. (Price \$4.50)

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Specification for Signal Colors Exclusive of Signal Glasses,
Manual Part 273.

COMMITTEE VIII—HIGHWAY GRADE CROSSING PROTECTION

Personnel

W. H. Stilwell, Chairman

H. T. Fleisher, Vice-Chairman

H. A. Appleby	H. C. Sampson
P. H. Foley	E. J. Seybold
A. M. Gilbert	R. H. Smedley
S. B. Higginbottom	W. R. Smylie
J. E. K. Krylow	J. L. Weatherby
S. W. Law	L. S. Werthmuller
B. F. McGowan	A. W. Wilson
H. G. Morgan	H. D. Blake*
P. H. Peters	R. B. Elsworth*
W. F. Price	H. A. Franklin*
L. McNally*	

Signal Section, A.A.R.:

The following outline of work has been assigned:

1. Revision of Manual.
2. Indexing signal literature.
3. Report on noteworthy developments in highway grade crossing protection.
4. Investigate and report on the use of diffusing lenses in electric light units for highway crossing signals to provide a wider range of indication where a long view is not required.
5. Prepare typical location plans for highway grade crossing protection devices.
6. Investigate and report on the durability and methods of maintenance of reflectorized signs.
7. Investigate and report on desirable uniform practice or practices concerning action to be taken by highway users when various types of highway grade crossing protection devices indicate the approach of trains.
8. Investigate and report on methods for preventing unnecessary operation of automatic highway grade crossing protection devices.

The Committee submits for consideration, reports on the following subjects**:

1. Revision and consolidation of Specification 176-41, Manual Part 149 and Specification 209-50, Manual Part 179.

Revision of Signs used in Connection with Manually Protected Railroad-Highway Grade Crossings, and Advance Warning Signs, Manual Part 269.

* Consulting Member.

** Suggestions or criticisms should be submitted in writing to the Chairman of the Committee on or before September 1, 1952.

4. Use of diffusing roundels in electric light units for highway crossing signals to provide a wider range of indication where a long view is not required.

8. Methods for preventing unnecessary operation of automatic highway grade crossing protective devices.

Information

Specifications, etc., of other organizations referred to in the report of this Committee may be procured from the following:

A.I.E.E.—American Institute of Electrical Engineers, 33 W. 39th St., New York 18, N. Y.

A.R.E.A.—American Railway Engineering Association, 59 E. Van Buren St., Chicago 5, Ill.

(Revision and Consolidation of A.A.R. Signal Section Specifications 176-41 and 209-50)
A.A.R. SIGNAL SECTION SPECIFICATION 176-52.

AUTOMATIC HIGHWAY GRADE CROSSING SIGNALS AND DEVICES

General Provisions

1. *Purpose.*

(a) This specification is for the purpose of providing for the installation of automatic highway grade crossing signals and devices. It sets forth specific detail requirements representing modern signal practice recommended for new installations and for the replacement of existing installations when general renewal or replacement becomes desirable.

2. *Details of work.*

(a) The installation shall include the following features:

1. Track to be provided with operating circuits.
2. Power supply.
3. Distributing system:
 - (a) Aerial.
 - (b) Surface.
 - (c) Underground.
4. Foundations.
5. Signals.
6. Gates.
7. Gate operating mechanisms.
8. Bells.
9. Conduits and supports.
10. Wires and cables.
11. Instrument and battery housings.
12. Insulation.
13. Painting.
14. Bonding.
15. Energy for operating gates, signals, track circuits, etc.
16.
17.

3. *Requisites, specifications, drawings and instructions.*

(a) Requisites, specifications, drawings and instructions referred to in the body of this specification form an essential part hereof.

(b) Purchaser shall furnish drawings which should include the following:

1. Track and signal plan drawn to scale showing track and highway with grades and alignments; signals and

Note.—The recommended forms of construction contract, proposal, and bond, will be found in Manual of the American Railway Engineering Assn., under the heading "Uniform General Contract Forms."

3. *Requisites, specifications, drawings and instructions.*—Continued.

switches, designating their normal position and whether interlocked or non-interlocked; location and capacity of existing junction boxes, relay and battery housings, power stations or source, existing and proposed highway crossing protection; pole line or other supports for line wires or aerial cables; kind and condition of ballast and such other physical characteristics or information as is desirable. Drawing....., dated

2. Plan showing any existing circuits that may effect the final circuit arrangement. Drawing, dated

3. Such standards and other drawings as the Purchaser considers desirable. Drawing, dated

(c) Contractor's drawings.

1. Contractor shall furnish with his proposal drawings or references for the apparatus he proposes to furnish, which are not covered by the drawings furnished by the Purchaser.

2. Within days after receipt of the drawings, the Purchaser will indicate any corrections that may be necessary, or signify his approval.

3. Contractor shall be responsible for the correctness of all drawings furnished by him, although the drawings may be approved by the Purchaser.

4. Any work done by the Contractor prior to the approval of the Contractor's drawings will be done at the Contractor's risk, unless previously authorized in writing by accredited representative of the Purchaser.

5. No change shall be made in any approved drawing without the written consent of the Purchaser.

6. After completion of the contract, the Contractor shall designate on station map the location of underground cables and such other information as may be required by the Purchaser and shall furnish corrected tracings of drawings furnished by him in accordance with section 3-e.

(d) Contractor shall furnish with his tender, drawings forming an essential part thereof.

(e) After award of the contract and before work is begun, the Contractor shall furnish for the approval of the Purchaser the following drawings as scheduled by the Purchaser:

1.
2.

4. *Furnished by the Purchaser.*

(a) Purchaser will obtain necessary permits from Federal, State and Municipal authorities.

4. *Furnished by the Purchaser.*—Continued.

(b) Purchaser will furnish, as indicated in sections 4-c, d and e, material or labor, or both, on the following items:

1. Ties for support of apparatus.
2. Move ties as may be necessary.
3. Move switch and tie rods as may be necessary.
4. Insulated rail joints.
5. Bridge insulations.
6. Switch-rod insulations.
7. Tie-rod insulations.
8. Gage-plate insulations.
9. Concrete material:
 - (a) Cement.
 - (b) Sand.
 - (c) Stone.
 - (d) Water.
10. Precast foundations.
11. Necessary grading and drainage.
12. Excavation of solid rock.
13. Poles for line wire.
14. Cross-arms, pins, insulators and fittings.
15. Line wire.
16. Housings:
 - (a) Instrument.
 - (b) Battery.
17. Cables:
 - (a) Aerial.
 - (b) Submarine.
 - (c) Underground.
 - (d)
18. Conduits:
 - (a) Main.
 - (b) Branch.
 - (c)
19. Manholes.
20. Track bonding.
21. Sand, clay or loam for cable trench, including protection plank.
22. Apply necessary attachments to signal apparatus in service.
23. Make necessary alterations of any part of existing structures or apparatus.
24. Make necessary alterations to existing circuits.
25. Unload and properly house material that arrives on the ground before the Contractor's force; this work to be done under the supervision of the Contractor's representative.
26. Distribute material.
27. Buildings.
28. Tools, fixtures for building and supplies required for the maintenance of the system.

4. *Furnished by the Purchaser.*—Continued.

29. Communication system.

30. Control panel for manual supervision.

31. Paint.

32.

33.

(c) Material only on items

(d) Labor only on items

(e) Material and labor on items

(f) Purchaser will furnish the items as indicated in sections 4-c, d and e, subject to inspection of the Contractor, who shall state any objections thereto before starting his part of the work. After rectification by the Purchaser of any defects reported, the Contractor shall assume full responsibility for the proper functioning of the installation. The intent of this section is to bar any claim by the Contractor that the work done by the Purchaser has not been performed in such manner as to enable him to fulfill all the provisions of the contract.

5. *Alternates.*

(a) The provisions contained in the alternate requisites section of this specification form a part hereof only when substituted by Purchaser's order for the provisions contained in this specification.

(b) Where blanks have not been filled, or where an option is permitted and no preference stated, the Contractor's recommended practice shall be followed.

6. *Shipment of material.*

(a) Material shall be shipped to, care of, marked for
Material shipped from Contractor's factory at
shall be shipped via and thence via
to destination.

7. *Transportation.*

(a) Purchaser will furnish transportation for men, necessary for the installation, over the following lines (*R-7-a):

1.

2.

(b) Purchaser will furnish transportation for tools and material, necessary for the installation, over the following lines (*R-7-b):

1.

2.

* Alternate requisites section.

8. *Inspection of installation.*

(a) Contractor shall advise the Purchaser days in advance of the time installation will be completed and ready for final inspection. Purchaser will make inspection and tests within days after completion of the work.

9. *Tests.*

(a) Contractor shall make such tests as may be necessary to demonstrate, to the satisfaction of the Purchaser, that the apparatus, as installed, is in accordance with the requirements of the specifications and contract. These tests, unless otherwise specified, shall include the tests shown in section 9-b and shall be conducted in accordance with A.A.R. Signal Section instructions for testing, where applicable, otherwise as directed by the Purchaser. Contractor shall provide such instruments and apparatus as may be necessary for making tests. Instruments and apparatus shall remain the property of the Contractor.

(b) The following tests shall be made:

1. General.

(a) Service test to determine that protective devices function as intended.

(b) Service test to determine that control system functions as intended.

(c) Test to determine that all circuits conform to approved circuit plans by individually electrically checking each contact selection.

(d) Test of all electrically operated devices to determine that electrical operating characteristics are in accordance with specifications designated by the Purchaser.

2. Insulation.

(a) Test of insulation resistance of each complete circuit, in accordance with Purchaser's instructions, shall be made when wires, cables and insulation involved are dry.

(b) Switch-rod insulation shall be tested in accordance with Specification 216, Manual Part 116.

3. Switch circuit controllers.

(a) Test to determine that switch circuit controllers are in accordance with Instructions for Switch Circuit Controllers, Manual Part 134.

4. Track circuits.

(a) Test to determine that track circuits have been installed in accordance with approved plans and adjusted in accordance with Instructions for Track Circuits, Manual Parts 8, 162 and 218.

9. *Tests.*—Continued.

5. Voltage.

(a) Test to determine that voltage for all apparatus is in accordance with Manufacturer's specifications and that voltage applied to lamps is in accordance with specifications furnished by the Purchaser.

10. *Placing in service.*

(a) After receipt of written authority from the Purchaser, the Contractor shall place the installation in service under supervision of the Purchaser, and shall leave competent men on duty for days thereafter. *R-10-a.

11. *Completion.*

(a) When installation is completed, apparatus and surface of the ground which has been affected by the installation, shall be left in a neat and clean condition.

12. *Clearances.*

(a) Clearances shall conform to clearance diagram furnished by the Purchaser.

*Detail Provisions*13. *Transformers.*

(a) Oil-cooled transformers shall be in accordance with Specification 84, Manual Part 165.

(b) Air-cooled transformers shall be in accordance with Specification 83, Manual Part 164.

(c)

14. *Rectifiers.*

(a) Rectifiers shall be of type.

(b) Rectifiers shall be in accordance with the following specifications, where applicable:

1. Copper-Oxide Rectifiers and Valves—Specification 166, Manual Part 139.

2. Tantalum Rectifiers and Valves—Specification 189, Manual Part 47.

3. Selenium Rectifier—Specification 229, Manual Part 243.

4. Rectifier—Specification, dated

(c) Track circuit rectifier characteristics.

1. A.C. volts, cycles

* Alternate requisites section.

14. *Rectifiers.*—Continued.

2. D.C. volts max., min., amperes max., min., for:
 - (a) Operating track circuits direct.
 - (b) Charging cells, type storage battery.
 - (c) Use in multiple with cells, ampere-hour type primary battery.
- (d) Line circuit rectifier characteristics.
 1. A.C. volts , cycles
 2. D.C. volts max., min., amperes max., min., for:
 - (a) Operating line circuits direct.
 - (b) Charging cells, type storage battery.
 - (c) Use in multiple with cells, ampere-hour type primary battery.
- (e) Signal operating rectifier characteristics.
 1. A.C. volts , cycles
 2. D.C. volts max., min., amperes max., min., for:
 - (a) Operating signals direct.
 - (b) Charging cells, type storage battery.
 - (c) Use in multiple with cells, ampere-hour type primary battery.
- (f) rectifier characteristics.
 1. A.C. volts , cycles
 2. D.C. volts max., min., amperes max., min., for:
 - (a)
 - (b) Charging cells, type storage battery.
 - (c) Use in multiple with cells, ampere-hour type primary battery.

15. *Foundations.*

- (a) The Purchaser will, in the presence of the Contractor's representatives, designate the location of each foundation.
- (b) Foundations shall be rigid and level.
- (c) Elevation and distance of foundations from track shall be in accordance with Purchaser's requirements.
- (d) Foundations for ground mast signals and instrument cases shall conform to Drawings 1107, 1259, 1687, 1694 and 1695. *R-15-d.
- (e) Foundations not otherwise specified shall be in accordance with Purchaser's requirements.

* Alternate requisites section.

15. *Foundations.*—Continued.

(f) Concrete foundations shall be allowed to properly set before any apparatus is connected thereto or placed thereon.

(g) Foundations shall be so constructed that apparatus can be removed without disturbing foundation.

(h) Dimensions of foundations shall be applicable to level and solid ground. The Purchaser and Contractor shall jointly decide when deviations from specified sizes are necessary.

(i) Foundations shall be provided by _____, in accordance with Specification _____, dated _____, and Drawing _____, dated _____.

16. *Concrete.*

(a) Concrete shall be in accordance with Purchaser's Specification _____, dated _____.

17. *Signals.*

(a) Signals shall conform to Drawing 1462, 1488, 1489, 1651, 1652, 1653, 1654, 1686 or 1688.

(b) Electric light unit for highway crossing signal shall be in accordance with Specification 190, Manual Part 166, or Specification 232, Manual Part 244.

(c) Electric motor mechanism and gate arms shall be in accordance with Specification 199, Manual Part 194.

(d) Crossing signals shall be in accordance with Requisites for Highway Grade Crossing Signals, Manual Part 148.

(e) Automatic gates shall be in accordance with Requisites for Automatic Gates, Manual Part 35.

(f) "No Right Turn" and "No Left Turn" signals shall be in accordance with Requisites for "No Right Turn" and "No Left Turn" Signals, Manual Part 224.

(g) Bells shall be in accordance with Specification 44, Manual Part 21.

18. *Controls.*

(a) Controls shall be in accordance with Requisites for Control of Automatic Highway Grade Crossing Signals and Devices, Manual Part 274.

19. *Wires and cables.*

(a) Wires and cables shall be in accordance with the following specifications:

1. Copper-Bearing Steel Line Wire—Specification 196, Manual Part 181.

2. Copper-Covered Steel Line Wire—Specification 167, Manual Part 180.

3. Copper Alloy Line Wire—Specification 168, Manual Part 173.

4. Copper Line Wire—Specification 169, Manual Part 182.

19. *Wires and cables.*—Continued.

5. Specification for Galvanized Steel Strand, Manual Part 184.
6. Specification for Bronze Guy and Messenger Strand, Manual Part 70.
7. Copper-Covered Steel Guy and Messenger Strand—Specification 173, Manual Part 69.
8. Insulated Wire, A.V.C.—Specification 192, Manual Part 187.
9. Insulated Wire—Specification 111, Manual Part 186.
10. Aluminum Cable Steel Reinforced Line Wire—Specification 54, Manual Part 24.
11. Braid-Covered Cable—Specification 89, Manual Part 25.
12. Lead Sheathed Cable, Submarine—Specification 90, Manual Part 26.
13. Lead Sheathed Cable, Non-Armored—Specification 91, Manual Part 28.
14. Lead Sheathed Cable, Armored—Specification 145, Manual Part 20.
15. Polychloroprene Sheathed Cable with Outer Covering—Specification 161, Manual Part 36.
16. Polychloroprene Sheathed Cable—Specification 240, Manual Part 249.
17.
18.

20. *Size of wire.*

- (a) Wire shall be of sufficient size to permit operation of signals in accordance with this specification.
- (b) Single-conductor wires outside buildings and instrument cases shall be not smaller than No. A.W.G.
- (c) Wires and cables shall be not smaller than No. A.W.G.
- (d) Line wires shall be not smaller than No. A.W.G. for hard-drawn copper or No. A.W.G. for copper-covered steel.
- (e) Common wire shall have conductivity of not less than that of No. A.W.G. hard-drawn copper.
- (f) Spare wires shall be provided as follows:
 1.
 2.
- (g) Track circuit wires shall be as follows:

	No. of conductors	A.W.G.	Wire or cable
1. Energy to rail.....			
2. Relay to rail.....			
3. Fouling shunt connections.....			

20. *Size of wire.*—Continued.

(h) Control wires shall be not smaller than No.
A.W.G.

21. *Wiring.*

(a) Wiring shall be in accordance with Specification 119, Manual Part 84.

(b) Lead cable underground without any other mechanical protection shall be placed in conduit.

(c) Wiring shall be handled in accordance with Instructions for Wire and Cable, Manual Part 190.

(d) Rubber-insulating tape and friction tape shall be in accordance with Specification 56, Manual Part 158 and Specification 88, Manual Part 157, respectively. *R-21-d.

(e) All wires shall be marked with tags in accordance with Purchaser's prescribed practice.

22. *Terminal blocks.*

(a) Terminal blocks shall conform to Drawing 1054, 1056 or 1077. *R-22-a.

23. *Fuses.*

(a) Fuses shall be:

	Type	Voltage	Capacity
1.			
2.			

(b) Fuse clips shall be mounted on insulating base of fireproof material.

(c) Necessary fuses to properly protect all apparatus and circuits as required by the Purchaser shall be installed by the Contractor. *R-23-c.

24. *Bonding.*

(a) Bonds shall be type and bonding installed in accordance with Specification 135, Manual Part 22. *R-24-a.

(b) Impedance bonds shall be in accordance with Specification 74, Manual Part 67.

25. *Power.*

(a) Two sources of power shall be provided for the operation of each crossing signal. Where commercial power is not available this provision may be accomplished by the use of two batteries with multiple connections between the two batteries.

26. *Batteries.*

(a) Batteries shall be in accordance with the following specifications and drawings:

* Alternate requisites section.

26. Batteries.—Continued.

1. Nickel, Iron, Alkaline Storage Battery—Specification 49, Manual Part 15.

2. Lead Acid Stationary Storage Battery (Plates of Pure Lead)—Specification 58, Manual Part 19.

3. Lead Type Portable Storage Battery for Signaling—Specification, dated

4. Lead Acid Stationary Storage Battery (Plates of Alloy Composition)—Specification 158, Manual Part 117.

5. Lead Acid Stationary Storage Battery (Plates of Composite Structure)—Specification 53, Manual Part 18.

6. Specification for Electrolyte, Manual Part 13.

7. Type "A" Copper-Oxide Caustic Soda Primary Cell—Specification 87, Manual Part 6.

8. Battery Jar (Primary)—Specification 113, Manual Part 9.

9. Battery Jar (Storage)—Specification, dated

10. Round Jars and Cover—Drawing 1053.

11. Rectangular Jars and Cover—Drawing 1419.

(b) Jars for caustic soda type of battery shall conform to Drawing, dated

(c) Track batteries shall be type and ampere-hour capacity.

(d) Line batteries shall be type and ampere-hour capacity.

(e) Operating batteries shall be type and ampere-hour capacity.

27. Relays.

(a) Direct current relays.

1. Tractive armature direct current neutral relays shall be in accordance with one or more of the following specifications:

(a) Two or More Contact Fingers—Specification 105, Manual Part 123.

(b) Series Line Approach Lighting—Specification 154, Manual Part 101.

(c) Interlocking Relay—Specification 186, Manual Part 105.

(d) Plug-in Type—Specification 204, Manual Part 77.

(e) Biased Neutral Relay—Specification 228, Manual Part 232.

(f) For Non-Vital Circuits—Specification 224, Manual Part 228.

(g) Detachable Type for Non-Vital Circuits—Specification 180, Manual Part 145.

27. *Relays.*—Continued.

(h) Track relays shall be of ohms resistance and have not more than nor less than contact fingers.

(i) Line relays shall be of ohms resistance and have not more than nor less than contact fingers.

2. Flasher relay shall be in accordance with Specification 185, Manual Part 143.

3. Time element relay shall be in accordance with Specification 197, Manual Part 1, or Specification 202, Manual Part 2.

4. Other types of direct current relays shall be as follows:

- (a)
- (b)

(b) Alternating current relays.

1. Relays shall be of the following type:

- (a)
- (b)

2. Alternating current relays shall be in accordance with Specifications 78 and 148, Manual Parts 122 and 53.

3. Track relays shall operate on and have contact fingers:

(a) Single-element volts cycles and not more than nor less than contact fingers.

(b) Two-element relays shall have not more than nor less than contact fingers and shall have windings for operation on:

- 1. Track winding volts cycles.
- 2. Local winding volts cycles.

4. Line relays shall operate on and have contact fingers.

(a) Single-element volts cycles and not more than nor less than contact fingers.

(b) Two-element relays shall have not more than nor less than contact fingers and shall have windings for operation on:

- 1. Line winding volts cycles.
- 2. Local winding volts cycles.

5. Power transfer relays shall be in accordance with Specification 148, Manual Part 53.

6. Other types of alternating current relays shall be as follows:

- (a)
- (b)

28. *Reactors and resistors.*

(a) Reactors shall be in accordance with Specification 104, Manual Part 121.

28. *Reactors and resistors.*—Continued.

(b) Resistors shall be in accordance with Specification 106, Manual Part 135.

29. *Lightning arresters.*

(a) Line arresters, type, shall meet A.I.E.E. requirements and shall be installed as shown on circuit drawings.

(b) Low-voltage arresters, type, shall meet the requirements of Specification 52, Manual Part 95, and shall be installed as shown on circuit drawings.

(c) Arrester grounds shall be in accordance with Specification 60, Manual Part 92. Contractor's liability is limited to grounding elements per ground.

30. *Bootlegs.*

(a) Bootlegs shall conform to Drawing, dated

31. *Track circuit connectors.*

(a) Track circuit connectors shall conform to Drawing 1047, 1048, 1631 or 1632. *R-31-a.

32. *Line construction.*

(a) Line construction shall be in accordance with Purchaser's prescribed practice.

33. *Conduits.*

(a) Conduits shall be in accordance with the following:

1. Specification for Fibre Conduit, Manual Part 37.
2. Specification for Communication Underground Conduit Construction, Manual Part 38.
3. Specification for Steel Pipe Conduit, Manual Part 39.
4. Specification for Wrought Iron Pipe Conduit, Manual Part 40.
5. Specification for Vitrified Clay Conduit, Manual Part 41.

34. *Instrument and battery housings.*

(a) Instrument housings shall conform to the following drawings:

1. Cable Post—Drawing 1192.
2. Relay Box Inlet Bracket—Drawing, dated
3. Relay Box Linings and Terminal Boards—Drawing, dated
4. Relay Box Fittings—Drawing, dated

* Alternate requisites section.

34. *Instrument and battery housings.*—Continued.

5. Relay Box and Cable Post Mountings—Drawing ,
dated

6. Steel Instrument House—Drawing , dated

7. Steel Instrument Case—Drawing 1601, 1626, 1627 or 1628.

8. Concrete housing shall conform to Drawing ,
dated

9. Relay racks shall conform to Drawing , dated

10.

(b) *Battery housings.*

1. Battery housings shall conform to Drawing ,
dated

2. Concrete battery boxes shall conform to Drawings 1266, 1267, 1268 and 1269.

3. Battery racks shall conform to Drawing ,
dated

35. *Insulated rail joints.*

(a) Insulated joints shall be type and for
section, lbs. rail with hole drilling.

(b) Insulated joints shall be installed in accordance with Instructions for Insulated Rail Joints, Manual Part 133.

(c) Insulated joints shall be located as shown on Drawings 1634, 1635, 1636, 1637 and 1638.

36. *Painting.*

(a) Painting shall be in accordance with Specification 120, Manual Part 110, and the following:

1. Requisites for Highway Grade Crossing Signals and Devices, Manual Part 274.

2. Requisites for "No Right Turn" and "No Left Turn" Signals, Manual Part 224.

37. *Padlocks.*

(a) Purchaser's padlocks shall be furnished by
and shall be used where specified.

38. *Circuit controllers.*

(a) Universal switch circuit controllers shall be in accordance with Specification 95, Manual Part 49. *R-38-a.

(b) Switch circuit controller connections shall conform to Drawings 1255, 1256, 1271 and 1272. *R-38-b.

(c) Switch circuit controllers shall be connected to the normally closed switch point.

* Alternate requisites section.

38. *Circuit controllers.*—Continued.

(d) circuit controllers shall be in accordance with

39. *Control panel.*

(a) Control panel for manual supervision design, shall be installed as shown on Drawing, dated

40. *Communication system.*

(a) Telephone systems shall be in accordance with A.A.R. Communications Section Specification.

(b) system shall be installed as specified by Purchaser.

41. *Fibre insulation.*

(a) Fibre insulation shall be in accordance with Specification 13, Manual Part 58.

42. *Electric lamps.*

(a) Incandescent electric lamps shall be in accordance with Specification 51, Manual Part 91, and conform to Drawings 1541, 1542 and 1543.

43. *Special items.*

(a)

Alternate requisites.

R-7-a.

Contractor will furnish transportation for men, necessary for the installation, over the following lines:

1.
2.

R-7-b.

Contractor will furnish transportation for tools and material, necessary for the installation, over the following lines:

1.
2.

R-10-a.

Purchaser will place the installation in service in the event that he does not authorize the Contractor to do so within days after completion of the work, to the Purchaser's satisfaction.

R-15-d.

Foundations for ground mast signals and instrument cases shall conform to Drawing, dated

Alternate requisites.—Continued.

- R-21-d. Insulating tape shall be in accordance with Purchaser's requirements.
- R-22-a. Terminal blocks shall be
- R-23-c. Fuses shall be installed as follows:
- R-24-a. Bonding shall be installed in accordance with Specification
....., dated
- R-31-a. Track circuit connectors shall conform to Drawing,
dated
- R-38-a. Switch circuit controllers shall be
- R-38-b. Switch circuit controller connections shall conform to

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter
in the Manual.

Subject-matter to be Superseded

Specification 176-41—Highway Grade Crossing Signals, Manual Part 149
and Specification 209-50—Highway Grade Crossing Automatic Gates,
Manual Part 179.

METHODS FOR PREVENTING UNNECESSARY OPERATION OF AUTOMATIC HIGHWAY GRADE CROSSING PROTECTIVE DEVICES

A.A.R. Signal Section Requisites for Control of Automatic Highway Grade Crossing Signals and Devices, Manual Part 274, read in Requisite 4-d as follows:

"Where train speeds on a given track vary considerably, a single operating circuit of such length as to provide adequate warning of the approach of trains at the higher speed may produce too long a warning time for slower trains. In such cases, additional operating circuits may be provided with timing devices so arranged that a warning time, not too long for the slower trains, will be automatically selected."

In order to obtain a preliminary summary of present practices in effect on various railroads and further to obtain information on means that are provided for avoiding the unnecessary operation of the crossing protective devices during intervals when trains make regular operating stops or perform switching operations on the approach circuits, a questionnaire was submitted to members of Committee VIII for a report regarding the practices on their railroads.

The replies indicate that local conditions appear on each railroad, requiring consideration of arrangements to avoid considerable differences in protective device operating time between high and low train speeds and where unnecessary operation of the devices may result by train making regular operating stop or performing switching operation on approach circuits. Consideration for eliminating these causes for unnecessary operation of protective devices is indicated wherever required by State regulations, railroad traffic conditions or highway traffic conditions.

The replies made by 14 members of Committee VIII, covering the conditions and practices on 12 railroad systems which operate in areas that generally reflect the entire United States, reveal many local conditions which require special circuits and which also require in many instances special operating rules or instructions.

The questions submitted with a summary of the answers, follow:

1. Slow train approaching on main track where trains are also operated at high speed.

All 14 replies indicated the use of selective speed controls where required by State regulations, railroad traffic conditions or highway traffic conditions. Nine of the replies made no qualifications as to the application; five qualified their information as applying to gate installations only.

2. Train making station stop or stopping to take coal or water, in approach control circuits.

Of the 14 replies received 13 indicated use of a cut-out and one the use of a cut-out where selective speed controls were not used. Thirteen indicated automatic time cut-out and one manual cut-out. Eight replies mentioned the use of positive restart with the automatic time cut-out; one indicated use of track instrument for restart in special cases; one indicated manual automatic restoration.

3. Train leaving siding and moving away from crossing in approach control circuit.

Thirteen replies were received, of which 11 indicated reverse switch cut-out and 2 automatic time cut-out.

4. Train performing switching within the limits of the approach control circuits.

All replied to this question, 10 indicating automatic time cut-out; 1 manual cut-out; 3 automatic time or reverse switch cut-out. Six indicated positive restart; 1 manual restart; 1 track instrument restart; 2 special circuits with operating instructions.

5. Train stopped by a controlled signal within limits of the approach circuit.

All replied that circuits are provided to prevent operation of crossing protection when signal indicates Stop.

6. Train leaving cars in approach control circuit. Indicate minimum permissible length of positive restart section.

Nine replies were received to this question. In general, the replies indicate that positive restart sections vary up to a maximum of 600 feet. In the absence of positive restart sections or where extreme short sections are used, operating instructions are necessary.

In addition to the digest of the answers to the questionnaire as reported in the foregoing, a special review was made of methods that are being used to engineer highway grade crossing device installations so as to meet the full requirements of each installation as related to highway traffic problems, local government problems and railroad operating problems. It was clearly revealed that careful preliminary studies should be made on the ground by railroad operating and signal representatives along with State Highway and Public Commission personnel, before final plans are made.

One railroad involved in this study has made a concerted effort to follow this practice and reports very successful cooperation with resultant satisfaction in the operation of its devices both from the railroad standpoint and public use standpoint. A brief outline of the procedures followed by this railroad for a typical location and results obtained, follows:

Automatic flashers and gates with sidewalk arms were requested by county authorities for a crossing located within interlocking limits intersecting three main tracks at right angles, the approaches of which would include three suburban passenger depots. In addition, the crossing is so located with respect to the receiving and departing yards, which are located on opposite sides of the main tracks, that all movements of inbound and outbound freight trains as well as movements from one yard to the other are made over this crossing.

Vehicular and pedestrian traffic over this crossing in a 24-hour period consists of 386 pedestrians, 756 trucks, 4,507 automobiles, 128 buses and 22 bicycles, totaling, 5,801.

Railroad traffic at this crossing consists of 97 passenger trains, 41 freight trains and 72 switching movements, totaling 210 gate operations in a 24-hour period. Maximum speed over this crossing is 75 miles per hour.

After a thorough check on the ground with all interested parties, at which time it was determined that automatic protection would be practical, the matter was presented to the city authorities for their concurrence in replacing the manual protection with automatic protection. At the beginning, the city objected to the proposed change due mainly to the fact that they were unaware that such automatic protection could be made to operate with a minimum of delay to highway traffic. After a detailed explanation of the proposed protection, the city withdrew its objection and with the concurrence of the Public Commission, the automatic flashers and gates were installed and placed in service February 1949.

In the design of the control circuits for this installation, a careful analysis of all known devices and circuits was made in order to provide the maximum in safety and efficiency. Selective speed controls, bypasses with control signal in Stop position and route selections along with directional stick, interlocking and quick-acting track relays were used in this installation. Periodic operational checks of the installation show the approach operating time varying between 20 and 43 seconds for all movements over this crossing. Since these automatic flashers and gates have been installed, they have operated without criticism and there have been no accidents at this crossing in so far as the automatic protection is concerned.

Favorable results with this method of handling highway grade crossing protection installations are shown by the fact that this railroad has made a considerable number of complex installations in a like manner which resulted in a marked reduction of crossing accidents and a much improved attitude of the traveling public toward automatic highway grade crossing protection.

Action Recommended

Acceptance as information.

PROGRESS REPORT

USE OF DIFFUSING ROUNDELS IN ELECTRIC LIGHT UNITS FOR
HIGHWAY CROSSING SIGNALS TO PROVIDE A WIDER RANGE
OF INDICATION WHERE A LONG VIEW IS NOT REQUIRED*

Roundels normally used in highway traffic light type signals were obtained and tested by the Committee, to determine their value in railroad flashing light highway signal installations to provide a wider range of indication where a long view is not required. Five roundels normally used in flashing light signals were also obtained for test and comparison purposes.

Manufacturers' curves showing the horizontal and vertical light distribution of clear roundels projected on a parallel plane at 10 feet were obtained. These curves were compared visually with the light output pattern from each of the test roundels listed below by projecting beams on a wall at right angles to the roundel. A 30 degree spreadlight roundel with 15 degree downward deflection was used as a further comparison. Patterns as observed were found to be essentially as shown from the curves.

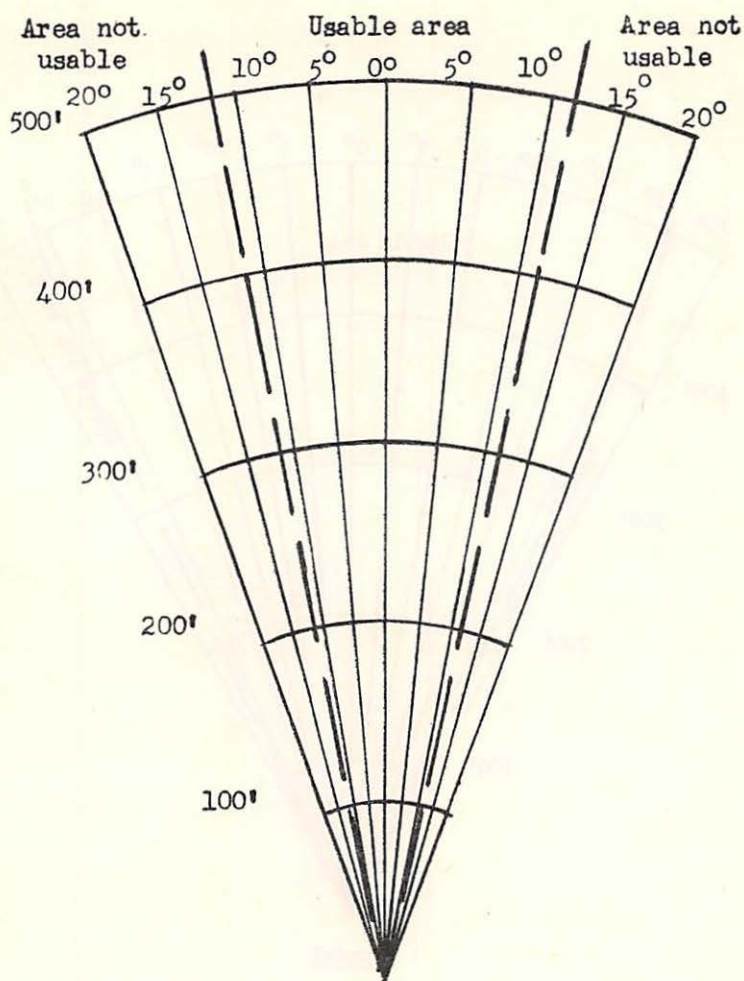
The following roundels were used:

1. 30-degree spreadlight with 15-degree downward deflection.
2. 70-degree horizontal spreadlight without downward deflection.
3. 20-degree horizontal spreadlight with 32-degree downward deflection.
4. Diffusion deflection. Kopp 27. (Curves 4A and 4B.)
5. 30-degree horizontal spreadlight.
6. D Style B-B Traffic Corning 14521.
7. Diffusing Kopp TL 4620.
8. Diffusing Kopp 88 A.
9. Diffusing Kopp 66.
10. Diffusing Corning 553400.
11. Diffusing Corning ME 4969.

A pair of A.A.R. Signal Section Specification 190-50, Manual Part 166, light units was mounted facing in an easterly direction at 7 feet 10 inches above the ground and 2 feet 6 inches apart. Stakes radiating from the units were driven into the ground at stations of a 100-foot interval between zero and 500 feet on a reference line and at 15 and 30 degrees from the reference line. The light units were opened, focused and aligned to give maximum beam intensity at eye level, 200 feet from the mast on the reference line. Ten-volt, 18-watt lamps were used throughout the test, burning at 10 volts.

Daylight observations between the hours of 10:00 a.m. and 3:00 p.m., in sunlight, were made at 100-foot intervals on the reference line and at 5, 10, 15, 20, 25 and 30 degrees from the reference line. The results were plotted graphically and confirmed by observation on the ground. See curves 1 to 11, inclusive.

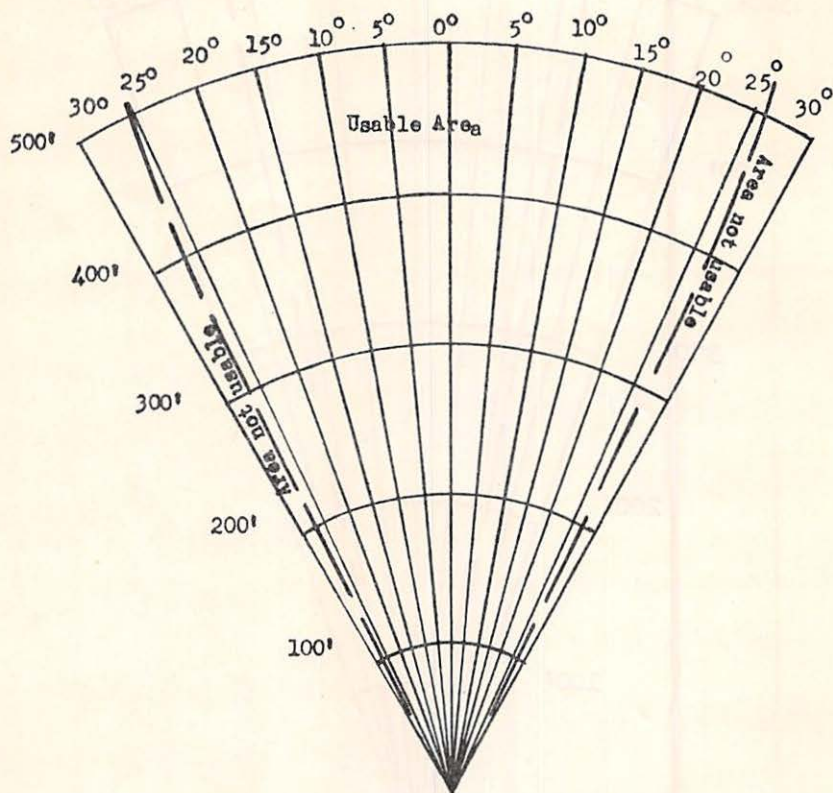
* Previous report on this subject appears in A.A.R. Signal Section 1947 Proceedings, Vol. XLV, pp. 271 and 414.

Roundel

30° spreadlight - 15° downward deflecting
Kopp 4564

Edges of usable area sharply defined

CURVE 1

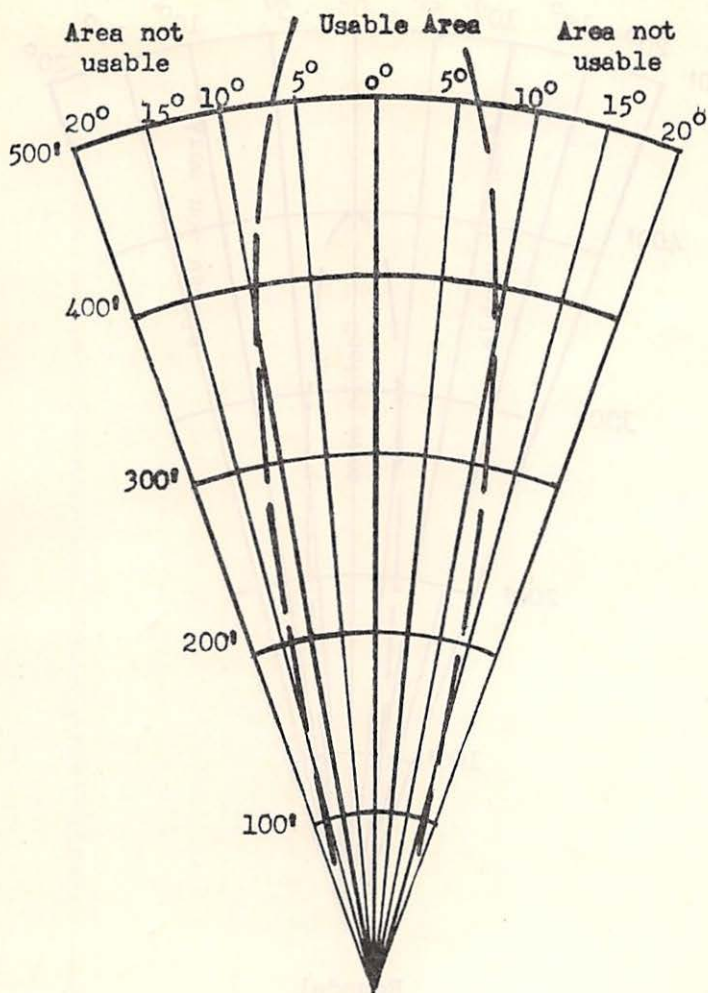


Roundel

70° horizontal spreadlight

Border line between usable and nonusable area about
5° wide

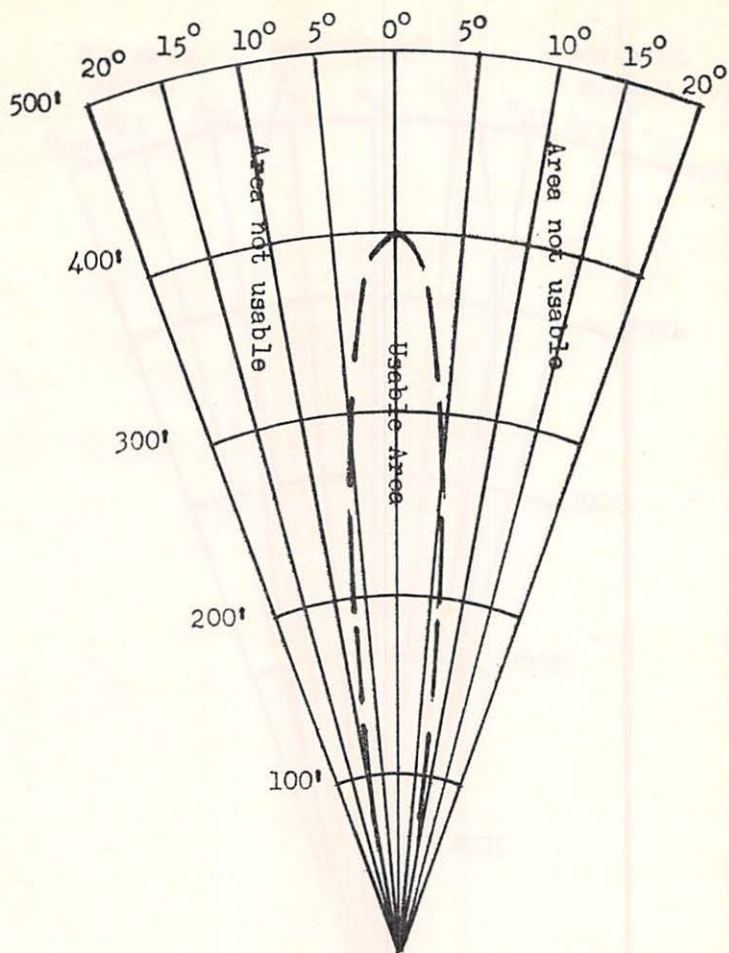
CURVE 2

Roundel

20° horizontal spreadlight with 32° downward deflection
 Corning 55472

Edges of usable area sharply defined

CURVE 3

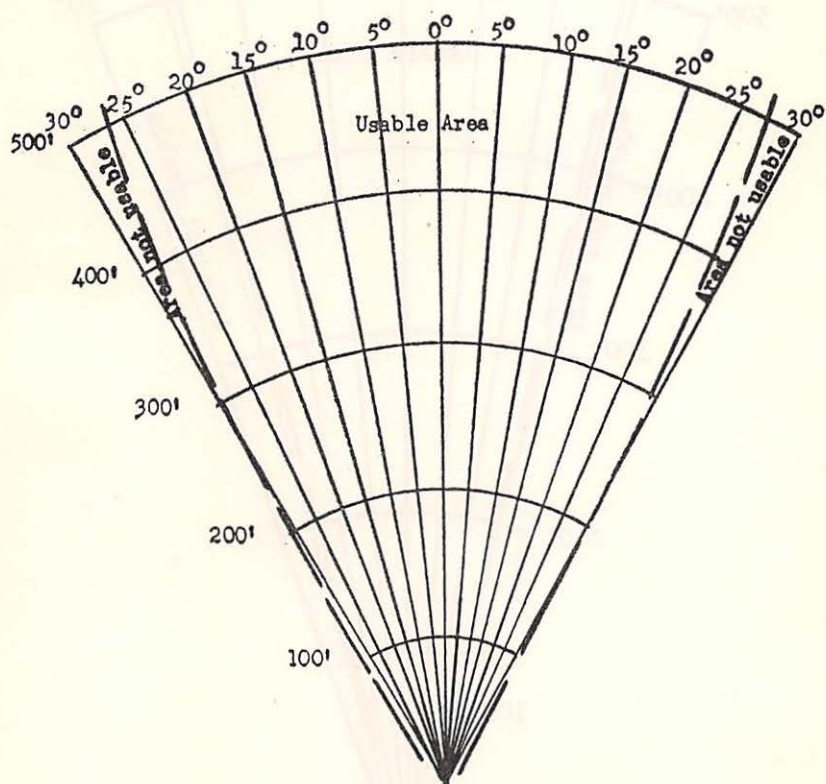


Roundel

Diffusing deflection
Kopp 27

border line between usable and nonusable area about
10° wide

CURVE 4A

Roundel

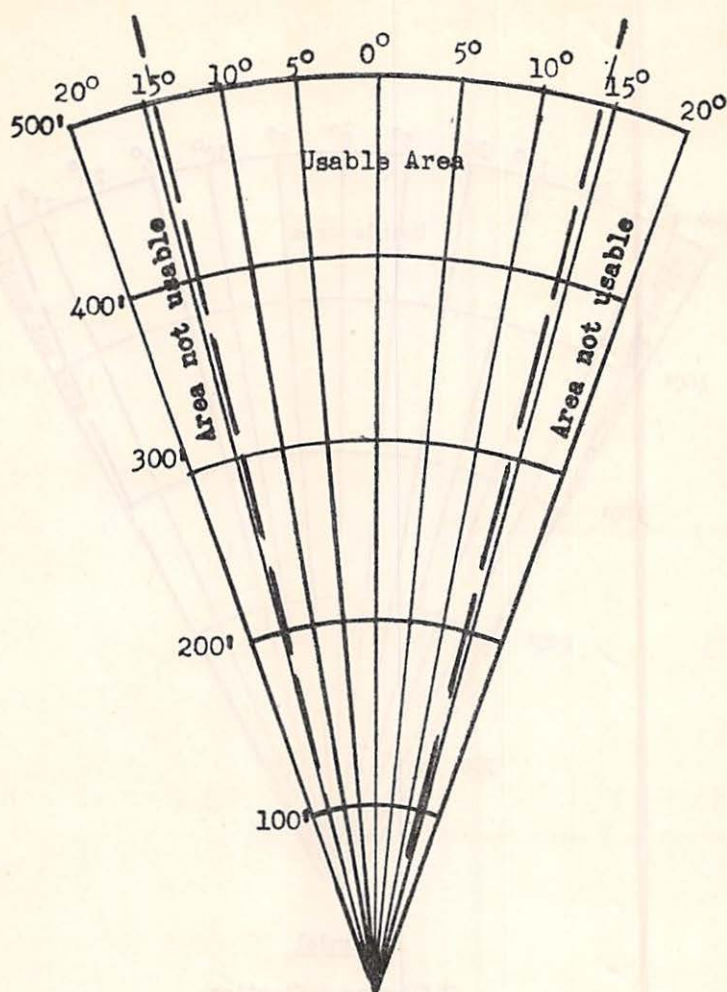
Diffusing deflection

Kopp 27

Lined 5° above horizontal

Border line between usable and nonusable area about
5° wide

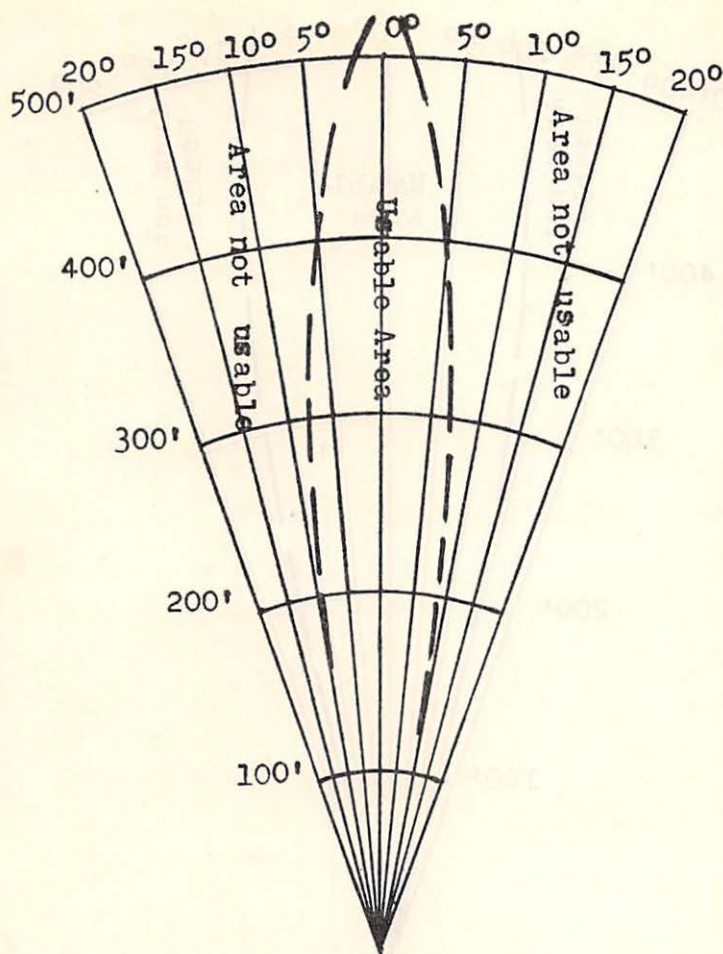
CURVE 4B

Roundel

30° horizontal spotlight

Edges of usable area sharply defined

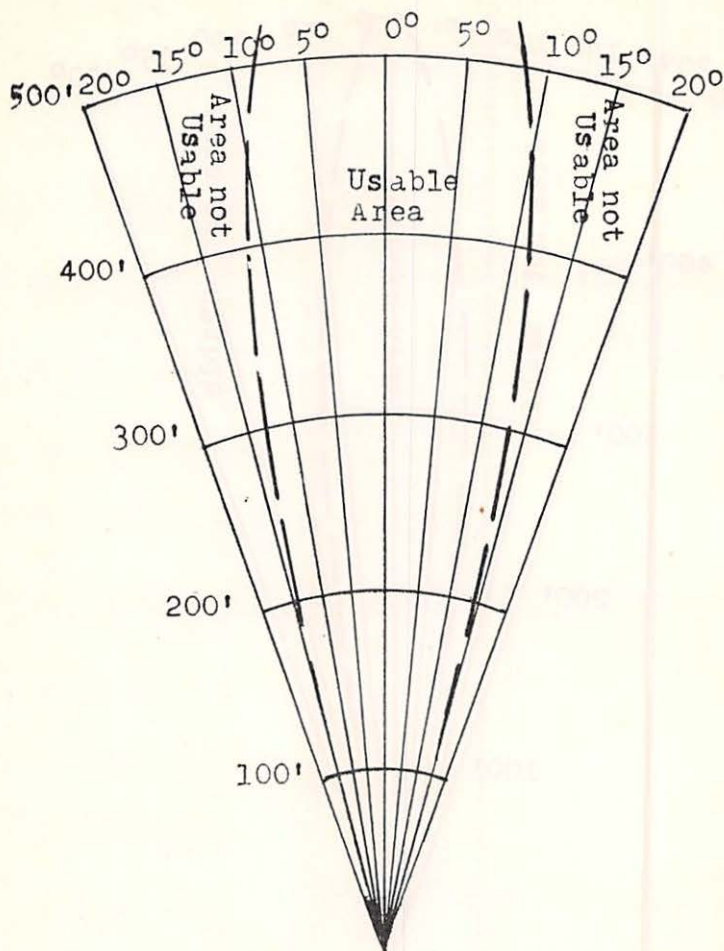
CURVE 5

Roundel

D Style B-B traffic
Corning 14521

Border line between usable and nonusable area about
 5° wide

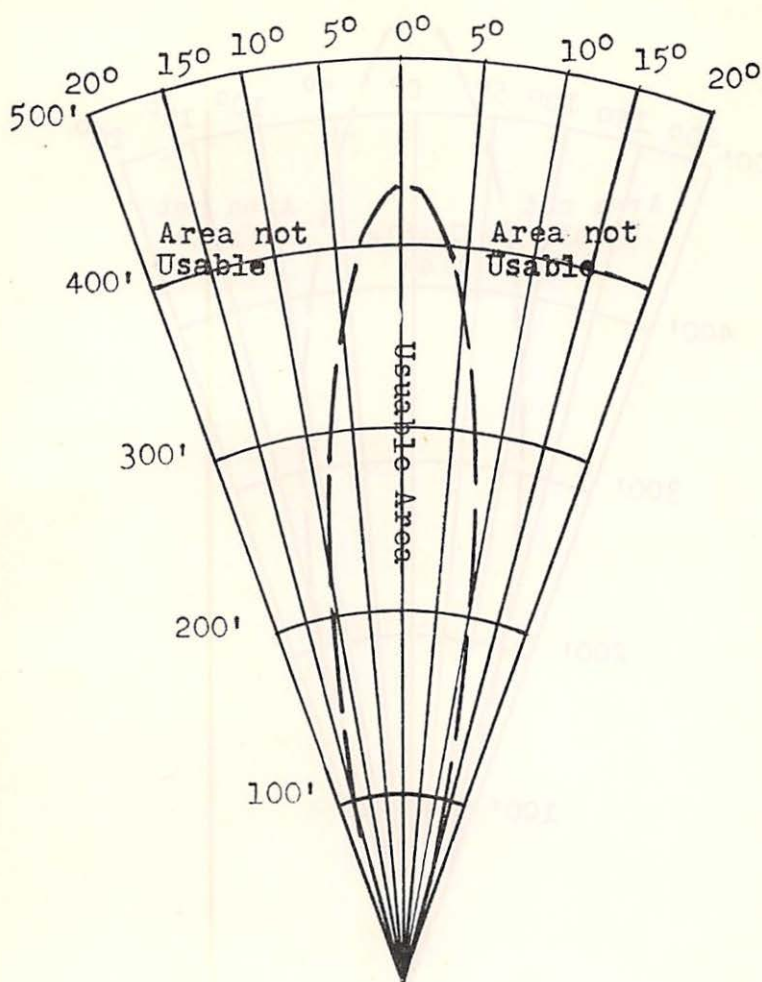
CURVE 6

Roundel

Diffusing
Kopp TL 4620 /

Border line between usable and nonusable area about
10° wide

CURVE 7

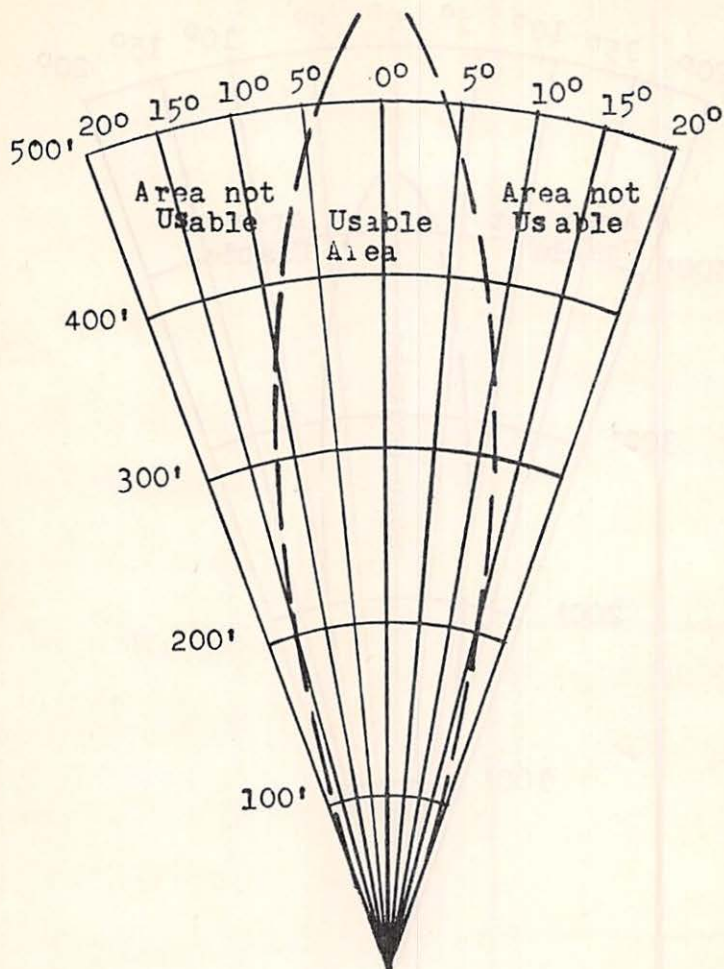


Roundel

Diffusing
Kopp 884

Border line between usable and nonusable area about
10° wide

CURVE 8

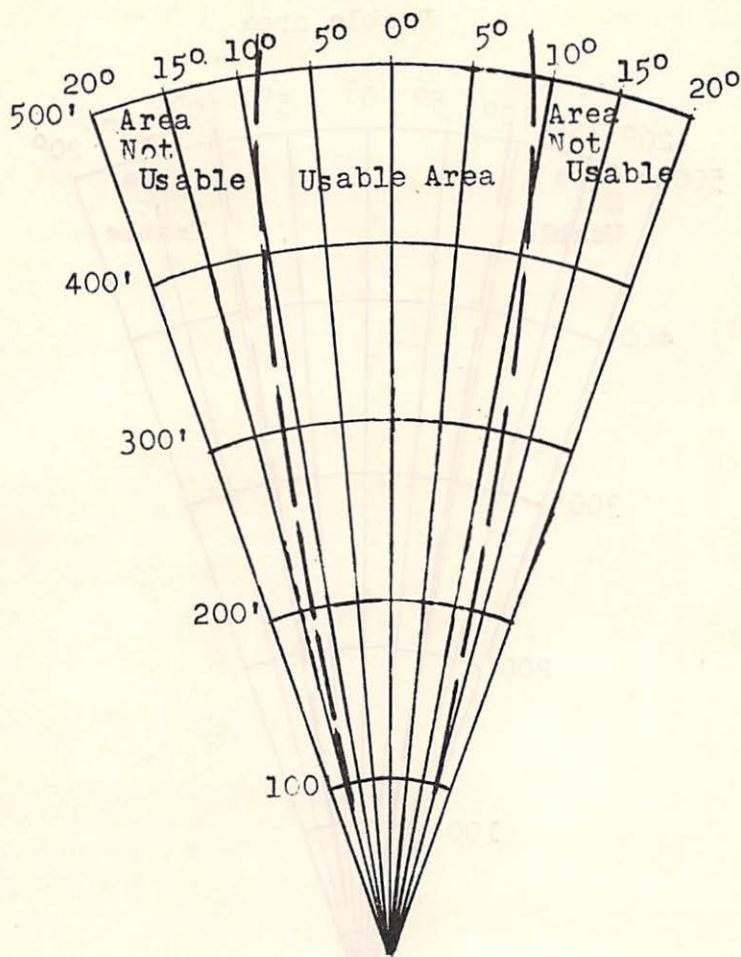


Roundel

Diffusing
Kopp 66

Border line between usable and nonusable area about
10° wide

CURVE 9

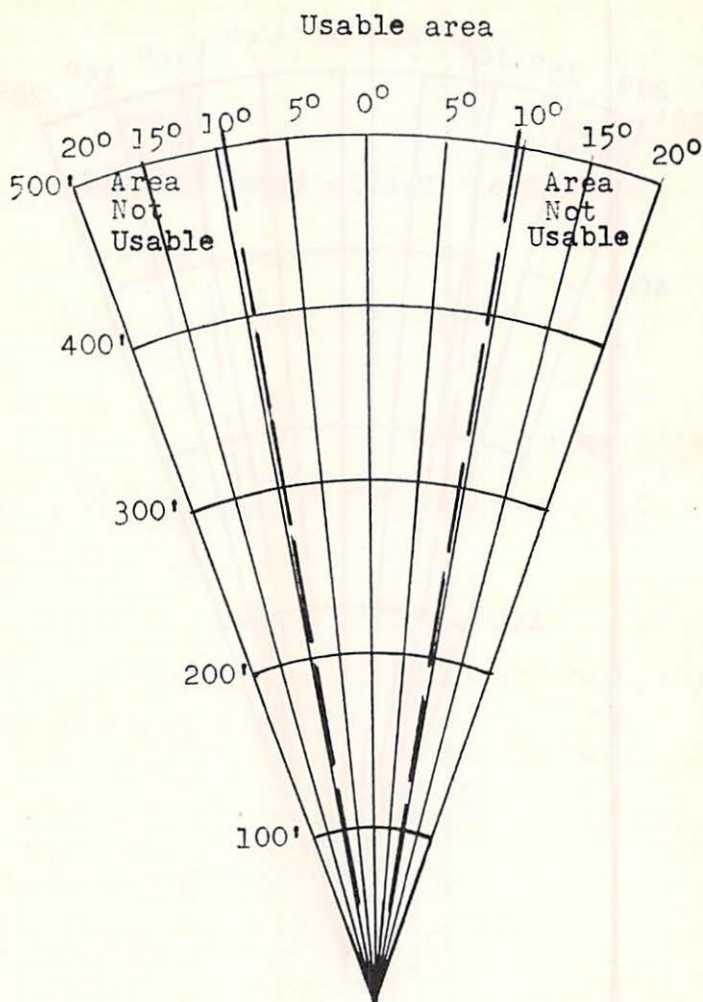
Roundel

Traffic

Corning 553400

Border line between usable and nonusable area about
10° wide

CURVE 10



Traffic
Corning ME 4969

Edges of usable area sharply defined

CURVE 11

Data for plotting curves were taken by standing at the axial line of the light units at each of the designated 100-foot stations and then walking back and forth through the angular range of the light units. The angle of spread was determined by ascertaining the point on each side of the base line where the intensity of illumination became materially below normal. This process was repeated for each of the 100-foot station intervals. By this method it is possible to determine points and to construct lines where the intensity of illumination falls off so as to be clearly insufficient.

The area contained within the constructed lines formed by these points, centered about the axis, has been termed the "inner zone" and represents illumination of an intensity deemed to be reasonably sufficient at all points. This does not mean the illumination is uniform at any particular station across this zone but that sufficient illumination is provided in all areas of the zone for warning to highway traffic at railroad grade crossings.

The area outside the inner zone has been termed the "outer zone" and is considered as illumination of too low intensity to meet the needs for warning highway traffic at railroad grade crossings.

All observations were made in comparison with 30-degree spreadlight with 15-degree downward deflecting roundel. In addition, a 30-degree deflecting roundel and a 20-degree roundel with 32-degree downward deflection were observed.

One of the test light units was aligned upward 5 degrees from the original alignment and observations of each of the roundels were made as before. No improvement was observed in any of these except the Kopp 27. The improvement in this roundel is shown by curve 4B. It appears with proper alignment this roundel will give a wide angle of satisfactory close-up indication. Although the curves for the Kopp 27 aligned 5 degrees above horizontal and the 70-degree spreadlight appear the same, it was found that the Kopp 27 gave a more uniform appearance over the inner zone than the 70-degree spreadlight.

Action Recommended

Acceptance as information.

(Revision of Signs Used in Connection With Manually Protected Railroad Highway Grade Crossings, and Advance Warning Signs)

SIGNS USED IN CONNECTION WITH MANUALLY PROTECTED RAILROAD-HIGHWAY GRADE CROSSINGS

1952

The recommended signs used in connection with manually protected railroad-highway grade crossings are as follows:

	Manual— American Railway Engineering Association
Reflector "Watchman Off Duty" Sign.....	Page 9-77
Reflector "Gates Not Working" Sign.....	Page 9-78
Mounting of Reflector Signs.....	Page 9-79
Cover Plates for Signs.....	Page 9-80

These drawings also appear in the current Bulletin on Railroad-Highway Grade Crossing Protection, issued by Train Operation, Control and Signals, A.A.R.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Signs Used in Connection With Manually Protected Railroad Highway Grade Crossings, and Advance Warning Signs, Manual Part 269.

COMMITTEE IX—OVERHEAD AND UNDERGROUND LINES

Personnel

W. W. Beard, Chairman

R. C. Steele, Vice-Chairman

H. H. Cooper

R. H. Smedley

R. W. Margsh

V. O. Smeltzer

M. A. Nyberg

E. P. Stephenson

C. L. Summers

Signal Section, A.A.R.:

The following outline of work has been assigned:

1. Revision of Manual.
2. Indexing signal literature.
3. Investigate and report on wire used in instrument cases and housings, panel and interlocking machines and track model boards.
4. Investigate and report on the difficulties experienced with Signal Section specifications parkway type track wire protective coverings and if found desirable recommend something physically stronger which will better withstand roadway stresses encountered.
5. Investigate and report on extent of failures in Signal Section specifications underground cables attributed to damage caused by rodents, micro-organisms or termites and recommend protection against such damage.
6. Investigate and report on wire used for internal wiring of all types of apparatus.

The Committee submits for consideration, reports on the following subjects*:

1. Revision of Specification 91-50, Manual Part 28.
Revision of Specification 145-50, Manual Part 20.
Revision of Specification, 90-50, Manual Part 26.
Revision of Specification 240-50, Manual Part 249.
Revision of Specification 161-50, Manual Part 36.
Revision of Specification 89-50, Manual Part 25.
Revision of Specification 111-50, Manual Part 186.
Revision of Specification 192-40, Manual Part 187.
Revision of Specification 169-48, Manual Part 182.
Revision of Specification 168-48, Manual Part 173.
Revision of Specification 167-48, Manual Part 180.
Revision of Specification 196-48, Manual Part 181.
Revision of Specification 108-47, Manual Part 175.
Revision of Specification 70-47, Manual Part 176.
Removal of Wire Inspection Report from Manual Part 178.
Revision of Specification 22-46, Manual Part 177.
Revision of Specification 54-39, Manual Part 24.
Removal of Specification for Vitrified Clay Conduit from Manual Part 41.
- Cooperative report. American Society for Testing Materials, Subcommittee IX—Insulating Tapes (Committee D-11—Rubber Insulating Materials).

* Suggestions or criticisms should be submitted in writing to the Chairman of the Committee on or before September 1, 1952.

Information

Specifications, etc., of other organizations referred to in the report of this Committee may be procured from the following:

A.S.A.—American Standards Association, 70 E. 45th St., New York 17, N. Y.
A.S.T.M.—American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.

(Revision of A.A.R. Signal Section Specification 91-50)
A.A.R. SIGNAL SECTION SPECIFICATION 91-52.

LEAD SHEATHED CABLE, NON-ARMORED

Proposed Revision

(This revision is a change in title of the specification only.)

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Title of Specification 91-50—Single and Multiple-Conductor
Insulated Lead Sheathed Cable, Manual Part 28.

(Revision of A.A.R. Signal Section Specification 145-50)
A.A.R. SIGNAL SECTION SPECIFICATION 145-52.

LEAD SHEATHED CABLE, ARMORED

*Proposed Revision*1. *Purpose.*

(a) This specification is for the purpose of providing for single and multiple-conductor, insulated, lead-sheathed signal cable with flat metallic tape armor for installation in direct contact with the earth, in ducts, in the air or in any combination of these types of installation and for use on circuits rated at 0-600 and 601-2500 volts. It sets forth specific detail requirements representing modern signal practice recommended for new installations and for replacement on existing installations when general renewal or replacement becomes desirable.

11. *Armoring.*

(a) The lead sheath shall be armored with flat metallic tapes laid over a jute bedding in accordance with current American Standard C8.15, sections pertaining to "Jute Bedding for Ar-

11. *Armoring*.—Continued.

mored Cables" and "Flat Steel Tape Armor, except jute serving overall," issued by the American Standards Association.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Title and sections 1-a and 11-a of Specification 145-50—Single and Multiple-Conductor, Insulated, Lead-Covered Parkway Cable, Armored With Flat Steel or Zinc Tape, Manual Part 20.

(Revision of A.A.R. Signal Section Specification 90-50)
A.A.R. SIGNAL SECTION SPECIFICATION 90-52.

LEAD SHEATHED CABLE, SUBMARINE

Proposed Revision

(This revision is a change in title of the specification only.)

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Title of Specification 90-50—Multiple-Conductor Insulated Submarine Cable Lead Sheathed and Round Steel Armored, Manual Part 26.

(Revision of A.A.R. Signal Section Specification 240-50)
A.A.R. SIGNAL SECTION SPECIFICATION 240-52.

POLYCHLOROPRENE SHEATHED CABLE

*Proposed Revision*7. *Insulation*.

(a) Conductors shall be individually insulated with a properly vulcanized synthetic rubber-like compound which shall be homogeneous in character, tough, elastic and applied concentrically about the conductor, and shall fit tightly thereto. Where insulation is applied in more than one layer, adjacent layers shall be vulcanized into a homogeneous mass. The insulation shall be in accordance with A.S.T.M. Specification D 27-46T, sections pertaining to "Insulation," except as modified by this specification. Sections 9, 10, 11 and 13 of Specification D 27-46T do

7. *Insulation.*—Continued.

not apply. The insulation shall be in accordance with the following minimum performance requirements (*R-7-a):

1. Physical properties:

Tensile strength, min. psi.....	850
Elongation at rupture, min. per cent.....	300
Set in 2 in. gage length, max. in.....	1/2
Depreciation in tensile strength and elongation after 96 hours in oxygen pressure test, max. per cent.....	35

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Title and section 7-a-1 of Specification 240-50—Single and Multiple-Conductor, Insulated, Polychloroprene Compound Sheathed Cable, Manual Part 249.

(Revision of A.A.R. Signal Section Specification 161-50)
A.A.R. SIGNAL SECTION SPECIFICATION 161-52.

POLYCHLOROPRENE SHEATHED CABLE WITH
OUTER COVERING*Proposed Revision*1. *Purpose.*

(a) This specification is for the purpose of providing for single and multiple-conductor, insulated signal cable with polychloroprene compound sheath for installation in direct contact with the earth, in ducts, in the air or in any combinations of these types of installation and on circuits rated at 0-600 and 601-2500 volts. It sets forth specific detail requirements representing modern signal practice recommended for new installations and for replacement on existing installations when general renewal or replacement becomes desirable.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Title and section 1-a of Specification 161-50—Single and Multiple-Conductor, Insulated, Non-Metallic Sheathed Cable, Manual Part 36.

(Revision of A.A.R. Signal Section Specification 89-50)
A.A.R. SIGNAL SECTION SPECIFICATION 89-52.

BRAID-COVERED CABLE

Proposed Revision

(This revision is a change in title of the specification only.)

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter
in the Manual.

Subject-matter to be Superseded

Title of Specification 89-50—Multiple-Conductor Insulated Cable With
Weather-Resistant or Flame-Retarding Moisture-Resistant Braid
Covering, Manual Part 25.

(Revision of A.A.R. Signal Section Specification 111-50)
A.A.R. SIGNAL SECTION SPECIFICATION 111-52.

INSULATED WIRE

Proposed Revision

1. *Purpose.*

(a) This specification is for the purpose of providing for single-conductor insulated signal wire with braid covering or polychloroprene compound outer sheath for use on circuits rated at 0-600 and 601-2500 volts when wire is not in direct contact with the earth. It sets forth specific detail requirements representing modern signal practice recommended for new installations and for replacement on existing installations when general renewal or replacement becomes desirable.

7. *Insulation.*

(a) Conductor shall be insulated with a properly vulcanized synthetic rubber-like compound which shall be homogeneous in character, tough, elastic and applied concentrically about the conductor, and shall fit tightly thereto. Where insulation is applied in more than one layer, adjacent layers shall be vulcanized into a homogeneous mass. The insulation shall be in accordance with A.S.T.M. Specification D 27-46T, sections pertaining to "Insulation," except as modified by this specification. Sections 9, 10, 11 and 13 of Specification D 27-46T do not apply. The insulation shall be in accordance with the following minimum performance requirements (*R-7-a):

* Alternate requisites section.

Alternate requisites.

R-7-a.

1. Conductor shall be insulated with a properly vulcanized rubber compound known as Class AO, 30 per cent Hevea rubber, and shall be in accordance with the composition, chemical, physical and electrical requirements for Class AO, 30 per cent Hevea rubber compound specified in A.S.T.M. Specification D 27-46T, sections pertaining to "Insulation."

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Title, sections 1-a, 7-a and alternate requisites section R-7-a of Specification 111-50—Single-Conductor Insulated Wire and Cable With Flame-Retarding, Moisture-Resistant or Weather-Resistant Braid Covering or Outer Polychloroprene Sheath, Manual Part 186.

(Revision of A.A.R. Signal Section Specification 192-40)
A.A.R. SIGNAL SECTION SPECIFICATION 192-52.

INSULATED WIRE, A.V.C.

Proposed Revision

1. *Purpose.*

(a) This specification is for the purpose of providing for single-conductor signal wire insulated with varnished-cambric, felted asbestos and cotton braid saturated with flame, heat and moisture-resistant compound for use in weather protected locations and on circuits rated at 0-600 volts. It sets forth specific detail requirements representing modern signal practice recommended for new installations and for replacement on existing installations when general renewal or replacement becomes desirable.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Title and section 1-a of Specification 192-40—Single-Conductor, Asbestos Varnished-Cambric Insulated Signal Wire With Flame-Retarding Braid Covering, Manual Part 187.

(Revision of A.A.R. Signal Section Specification 169-48)
A.A.R. SIGNAL SECTION SPECIFICATION 169-52.

COPPER LINE WIRE

Proposed Revision

1. *Purpose.*

(a) This specification is for the purpose of providing for solid hard-drawn copper line wire, with or without weather-resistant covering, for use on signal circuits. It sets forth specific detail requirements representing modern signal practice recommended for new installations and for replacement on existing installations when general renewal or replacement becomes desirable.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Title and section 1-a of Specification 169-48—Hard-Drawn Copper Wire
With or Without Weather-Resistant Covering, Manual Part 182.

(Revision of A.A.R. Signal Section Specification 168-48)
A.A.R. SIGNAL SECTION SPECIFICATION 168-52.

COPPER ALLOY LINE WIRE

Proposed Revision

1. *Purpose.*

(a) This specification is for the purpose of providing for copper alloy line wire, A.S.T.M. Grade No. 30, with or without weather-resistant covering, for use on signal circuits. It sets forth specific detail requirements representing modern signal practice recommended for new installations and for replacement on existing installations when general renewal or replacement becomes desirable.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Title and section 1-a of Specification 168-48—Copper Alloy Wire
With or Without Weather-Resistant Covering, Manual Part 173.

(Revision of A.A.R. Signal Section Specification 167-48)
A.A.R. SIGNAL SECTION SPECIFICATION 167-52.

COPPER-COVERED STEEL LINE WIRE

Proposed Revision

1. *Purpose.*

(a) This specification is for the purpose of providing for copper-covered steel line wire, 30 and 40 per cent conductivity, with or without weather-resistant coverings, for use on signal circuits. It sets forth specific detail requirements representing modern signal practice recommended for new installations and for replacement on existing installations when general renewal or replacement becomes desirable.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Title and section 1-a of Specification 167-48—Copper-Covered Steel Wire
With or Without Weather-Resistant Coverings, Manual Part 180.

(Revision of A.A.R. Signal Section Specification 196-48)
A.A.R. SIGNAL SECTION SPECIFICATION 196-52.

COPPER-BEARING STEEL LINE WIRE

Proposed Revision

1. *Purpose.*

(a) This specification is for the purpose of providing for galvanized copper-bearing steel line wire, with or without weather-resistant covering, for use on signal circuits. It sets forth specific detail requirements representing modern signal practice recommended for new installations and for replacement on existing installations when general renewal or replacement becomes desirable.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Title and section 1-a of Specification 196-48—Copper-Bearing Steel Wire
With or Without Weather-Resistant Covering, Manual Part 181.

(Revision of A.A.R. Signal Section Specification 108-47)
A.A.R. SIGNAL SECTION SPECIFICATION 108-52.

COPPER BOND WIRE

Proposed Revision

1. *Purpose.*

(a) This specification is for the purpose of providing for No. 6 A.W.G. copper wires for bonding rail joints for track circuit use. It sets forth specific detail requirements representing modern signal practice recommended for new installations and for replacement on existing installations when general renewal or replacement becomes desirable.

2. *Conductor.*

(a) The conductor shall be annealed copper, and have properties and characteristics in accordance with A.S.T.M. current Specification B 3 pertaining to conductor and as required by this specification. The wire shall be cut and straightened to the length specified on order. The ends shall be sheared-cut and free from burrs.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Sections 1-a and 2-a of Specification 108-47—Copper Bond Wire,
Manual Part 175.

(Revision of A.A.R. Signal Section Specification 70-47)
A.A.R. SIGNAL SECTION SPECIFICATION 70-52.

COPPER-COVERED STEEL BOND WIRE

Proposed Revision

1. *Purpose.*

(a) This specification is for the purpose of providing for No. 6 A.W.G. forty per cent conductivity copper-covered steel wires for bonding rail joints for track circuit use. It sets forth specific detail requirements representing modern signal practice recommended for new installations and for replacement on existing installations when general renewal or replacement becomes desirable.

2. *Conductor.*

(a) The conductor shall be composed of a steel core with a copper coat concentrically placed around and permanently welded thereto. The conductor shall be cylindrical in form and free from scales, flaws, inequalities, splits and all imperfections not consistent with good commercial practice. The wire shall be cut and straightened to length specified on order and be thoroughly annealed. The ends shall be sheared-cut and free from burrs.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Title and sections 1-a and 2-a of Specification 70-47—Forty Per Cent Conductivity Copper-Covered Steel Bonding Wire, Manual Part 176.

WIRE INSPECTION REPORT

As this subject-matter serves no useful purpose, it is recommended it be removed from Manual Part 178.

Action Recommended

Acceptance for submission to letter ballot for removal from the Manual. (Manual Part 178.)

(Revision of A.A.R. Signal Section Specification 22-46)
A.A.R. SIGNAL SECTION SPECIFICATION 22-52.

GALVANIZED E.B.B. STEEL BOND WIRE

Proposed Revision

1. *Purpose.*

(a) This specification is for the purpose of providing for No. 8 B.W.G. galvanized steel wires for bonding rail joints for track circuit use. It sets forth specific detail requirements representing modern signal practice recommended for new installations and for replacement on existing installations when general renewal or replacement becomes desirable.

2. *Conductor.*

(a) The conductor must be cylindrical in form, free from scales, flaws, inequalities, splits and all imperfections. The con-

2. *Conductor.*—Continued.

ductor shall be cut and straightened to the length specified on order. The ends shall be sheared-cut and free from burrs.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Sections 1-a and 2-a of Specification 22-46—Galvanized E.B.B. Steel Bond Wire, Manual Part 177.

(Revision of A.A.R. Signal Section Specification 54-39)
A.A.R. SIGNAL SECTION SPECIFICATION 54-52.

ALUMINUM CABLE STEEL REINFORCED LINE WIRE

Proposed Revision

1. *Purpose.*

(a) This specification is for the purpose of providing for aluminum cable steel reinforced for line wire. It sets forth specific detail requirements representing modern signal practice recommended for new installations and for replacement on existing installations when general renewal or replacement becomes desirable.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Title and section 1-a of Specification 54-39—Aerial Aluminum Cable Steel Reinforced, Manual Part 24.

SPECIFICATION FOR VITRIFIED CLAY CONDUIT

As the Specification for Vitrified Clay Conduit no longer appears in the Manual of the A.R.A. Telegraph and Telephone Section, now known as A.A.R. Communications Section, it is recommended that reference sheet, Manual Part 41, be removed from the Signal Section Manual.

Action Recommended

Acceptance for submission to letter ballot for removal from the Manual. (Manual Part 41.)

COOPERATIVE REPORT

AMERICAN SOCIETY FOR TESTING MATERIALS
SUBCOMMITTEE IX—INSULATING TAPES (COMMITTEE D-11—
RUBBER INSULATING MATERIALS)*

W. W. Beard, Representative

A meeting of A.S.T.M. Committee D-11 was held in Cleveland, Ohio, on March 5, 6 and 7, 1952.

Subcommittee IX met on March 6 at which time a proposed specification for ozone resistant rubber insulating tape similar to D-119-48T was considered. After considerable discussion on the method of testing for ozone resistance, the specification was held in abeyance pending further revision.

An item of interest to the Signal Section, and Signal Section Committee IX in particular, is revisions to A.S.T.M. Specification D-27-50T, Insulated Wire and Cable, Class AO. The details of the recommended revisions authorized for submission to letter ballot of Committee D-11 cover a revision to Table 1 on physical test requirements for insulation before and after aging tests. This revision, if adopted, may necessitate revisions of A.A.R. Signal Section wire and cable specifications.

Action Recommended

Acceptance as information.

* Previous report on this subject appears in A.A.R. Signal Section 1948 Proceedings, Vol. XLVI, pp. 362 and 475.

COMMITTEE X—SIGNALING PRACTICE

Personnel

G. K. Thomas, Chairman	
W. G. Salmonson, Vice-Chairman	
J. A. Beoddy	S. W. Law
C. M. Bishop	H. G. Morgan
J. J. Corcoran	S. E. Noble
E. N. Fox	W. S. Storms
H. B. Garrett	L. C. Walters
W. N. Hartman	J. S. Webb
T. W. Hays	W. W. Welsh

Signal Section, A.A.R.:

The following outline of work has been assigned:

1. Revision of Manual.
2. Indexing signal literature.
3. Report on noteworthy changes in signal practices.
4. Recommend uniform signal practice in the use of aspects and indications for railway signaling.
5. Requisites for automatic train control, automatic stop and cab signal systems.
6. Investigate and report on new and improved signal devices and related appliances.
7. Investigate and report on light out protection.
8. Investigate and report on the practicability of developing a portable speed recorder for determination of the speed of a passing train by direct reading.

The Committee submits for consideration, reports on the following subjects*:

1. Revision of Requisites for Centralized Traffic Control, Manual Part 86.
Revision of Signaling for Gravity Classification Yards, Manual Part 42.
3. Noteworthy changes in signal practices.
6. New and improved signal devices and related appliances.

Disposition of 1951 Letter Ballot Subjects

The following subjects presented by Committee X at the 1951 Annual Meeting were submitted to letter ballot and officially approved:

- Requisites for Protection for Spring Switches—Now in Manual Part 10.
Requisites for Automatic Block Signaling Systems—Now in Manual Part 87.
Requisites for Take or Leave Siding Indicator—Now in Manual Part 71.
Requisites for Interlocking—Now in Manual Part 94.

* Suggestions or criticisms should be submitted in writing to the Chairman of the Committee on or before September 1, 1952.

(Revision of Requisites for Centralized Traffic Control)
A.A.R. SIGNAL SECTION REQUISITES.

TRAFFIC CONTROL SYSTEMS

1952

1. These requisites are for the purpose of setting forth the recommended general requirements for traffic control systems. They set forth specific detail requirements representing modern signal practice recommended for new installations and for replacement of existing installations when general renewal or replacement becomes desirable.

2. All control circuits, the functioning of which affects safety of train operation, shall be designed on the closed circuit principle, except circuits for roadway equipment of intermittent automatic train stop system.

3. Each roadway signal shall be located over or to the right of the track it governs.

4. Aspects shall be shown by the position of semaphore blades, color of lights, position of lights, flashing of lights, or any combination thereof. They may be qualified by marker plate, number plate, letter plate, marker light, shape and color of semaphore blades, or any combination thereof, subject to the following conditions:

(a) Night aspects of roadway signals, except qualifying appurtenances, shall be shown by lights; day aspects by lights or semaphore arms. A single white light shall not be used.

(b) The fundamental indications of signal aspects shall conform to the following:

1. A red light, a series of horizontal lights, or a semaphore blade in a horizontal position shall be used to indicate Stop.

2. A yellow light, a lunar light, or a series of lights or a semaphore blade in the upper or lower quadrant at an angle of approximately 45 deg. to the vertical, shall be used to indicate that speed is to be restricted and stop may be required.

3. A green light, a series of vertical lights, or a semaphore blade in a vertical position in the upper quadrant, or 60 or 90 deg. in the lower quadrant shall be used to indicate Proceed at Authorized Speed.

5. Each roadway signal shall be located with respect to the next signal or signals in advance which govern train movements in the same direction so that the indication of a signal displaying a restrictive aspect can be complied with by means of a brake application, other than an emergency application, initiated at such signal, either by stopping at the signal where a stop is required, or by a reduction in speed to the rate prescribed by the next signal in advance where reduced speed is required.

6. A failure of a lamp in a light signal, or a semaphore signal arm assuming a false restrictive position, shall not cause the signal to display a more favorable indication than intended.

7. The battery or power supply for each signal control relay circuit, where

an open-wire line circuit or a common return circuit is used, shall be located at the end of the circuit farthest from the relay.

8. Signals governing movement at higher than restricted speed shall be controlled by continuous track circuits extending through the entire block. Also, in addition, at controlled point they shall be controlled by control operator, and, at manually operated interlocking, manually in cooperation with control operator.

9. On track signaled for movements in both directions, occupancy of the track between opposing signals at adjacent controlled points shall prevent changing the direction of traffic from that which obtained at the time the track became occupied.

10. Signals at a controlled point shall be so interconnected that aspects to proceed cannot be displayed simultaneously for conflicting movements.

11. Signals at adjacent controlled points shall be so interconnected that aspects to proceed cannot be displayed simultaneously for conflicting movements.

12. Signals governing movements over switches shall be so controlled that indications to proceed can be displayed only when such switches are in proper position.

13. Means shall be provided to insure that after a signal has been cleared, and the locking is effective, it cannot be restored manually to Stop by the operation of any lever other than its controlling lever.

14. Signal governing movements over hand-operated switch in the facing direction shall display its most restrictive aspect when the normally closed point is open $\frac{1}{4}$ in. or more and, in the trailing direction, $\frac{3}{8}$ in. or more, except that where a separate aspect is displayed for facing movements over the switch in the normal and in the reverse position, the signal shall display its most restrictive aspect when the switch points are open $\frac{1}{4}$ in. or more from either the normal or reverse position.

15. At hand-operated crossover between main track, protection shall be provided by one of the following:

(a) An arrangement of one or more track circuits, and switch circuit controllers.

(b) Facing point locks on both switches of the crossover, with both locks operated by a single lever.

(c) Electric locking of the switches of the crossover.

16. Signals governing movements over either switch of the crossover shall display their most restrictive aspect when any of the following conditions exist:

(a) Where protection is provided by one or more track circuits and switch circuit controllers, and either switch is open or the crossover is occupied by a train, engine, or car, in such a manner as to foul the main track.

(b) Where facing point locks with a single lever are provided, and either switch is unlocked.

(c) Where the switches are electrically locked, before the electric locking releases.

17. The circuits shall be so installed that each signal governing train movements into a block will display its most restrictive aspect when any of the following conditions obtains within the block:

- (a) Occupancy by a train, engine, or car.
- (b) When points of a switch are not closed in proper position.
- (c) When an independently operated fouling point derail equipped with switch circuit controller is not in derailing position.
- (d) When a track relay is in de-energized position, or when signal control circuit is de-energized.

18. The control circuit for power-operated or slotted mechanical signal, governing movements at higher than restricted speed over switches, movable point frogs, and derails, shall be selected through circuit controller operated directly by switch points or by switch locking mechanism, or through relay controlled by such circuit controller, for each switch, movable point frog, and derail in the routes governed by such signal. Circuits shall be so arranged that such signal can display an aspect to proceed only when each such switch, movable point frog, and derail in the route is in proper position.

19. Indication locking shall be provided for operative approach signals of the semaphore type, power-operated home signals, power-operated switches, movable point frogs and derails, and for all approach signals, except light signals all aspects of which are controlled by coded track circuits or by double-wire line circuits.

20. A signal shall be provided on main track to govern the approach with the current of traffic to any home signal except where the home signal is the first signal encountered when leaving yard or station and authorized speed approaching such signal is not higher than slow speed. When authorized speed between home signals on route governed is 20 miles per hour or less, an in-operative signal displaying an aspect indicating "approach next signal prepared to stop" may be used to govern the approach to the home signal.

21. The control circuits for aspects with indications more favorable than "proceed at restricted speed" shall be selected through track relays for all track circuits in the route governed or through repeating relays for such track relays. At automatic interlocking, signal control circuit shall be selected:

- (a) Through track relays for all track circuits in the route governed and in all conflicting routes within interlocking limits or through repeating relays for such track relays.
- (b) Through signal mechanism contacts or relay contacts closed when signals for such conflicting routes display stop aspects.
- (c) Through normal contacts of time releases for such conflicting routes or contacts of relays repeating the normal position of contacts of such time releases.

22. Signal control and electric locking circuits shall not be selected through the contacts of instruments designed primarily for indicating or annunciating purposes in which an indicating element attached to the armature is so arranged that it can in itself cause improper operation of the armature.

23. Occupancy of track circuits at controlled points shall be automatically indicated at the control station.

24. Approach or time locking shall be provided for all controlled signals and for all electric locks on hand-operated switches.

25. Route locking shall be provided where switches are power-operated.
26. Means shall be provided to indicate on the control machine when power-operated switch has completed its movement and is locked.
27. Each hand-operated switch in main track where train movements are made at speeds exceeding 20 miles per hour shall be electrically locked in normal position. Hand-operated switch electrically locked shall be operative as provided for in Requisites for Electric Locks Applied to Hand-Operated Switches for Protection of Main Track Movements, Manual Part 211.
28. Spring switches shall conform to Requisites for Protection for Spring Switches, Manual Part 10.
29. Take or leave siding indicators shall conform to Requisites for Take or Leave Siding Indicator, Manual Part 71.
30. Devices for providing protection against dragging equipment shall conform to Requisites for Dragging Equipment Detection, Manual Part 217.
31. Devices for providing protection against slides and rock falls shall conform to Requisites for Protection of Traffic Against Slides and Rock Falls, Manual Part 205.
32. Devices for providing protection against burned bridges or trestles, high-water hazards, and other similar protective devices shall be arranged to operate in conformity with the traffic control system.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Requisites for Centralized Traffic Control, Manual Part 86.

(Revision of Signaling for Gravity Classification Yards)

SIGNALING FOR GRAVITY CLASSIFICATION YARDS

1952

1. At yards where all cars are weighed when being classified, hump signals which display three indications are recommended.
2. At yards where none or only a part of the cars being classified are weighed, hump signals which display either four or five indications are recommended.
3. Color light signals.

Aspect	Indication
Red	Stop
Green	Proceed at normal hump speed
Yellow over yellow or Flashing yellow	Proceed at medium hump speed
Yellow	
Flashing red	Back up

Aspects and indications of signals of types other than color light shall be the equivalent of those shown.

4. Local conditions shall govern the number of repeater hump signals to be used.

5. In yards where it is necessary to make movements over humps from classification tracks, trimmer signals shall be provided and interconnected with hump signal and its repeaters so as to prevent hump operation while trimming movements are being made, except that circuit may be provided to permit trimmer movements while train is approaching hump. Trimmer signals which display two indications are recommended.

Color Light Signals

Aspect	Indication
Red	Stop
Yellow	Trim

Aspects and indications of signals of types other than color light shall be the equivalent of those shown.

6. Where cab signals are used their aspects and indications shall be in accordance with those for hump signals.

7. Where audible signals are used, in addition to visual signals, a code of sounds must be used which will provide a distinct indication to correspond to each visual indication, and must not be in conflict with Standard Code Rule 606.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Signaling for Gravity Classification Yards, Manual Part 42.

NOTEWORTHY CHANGES IN SIGNAL PRACTICES*

Signaling for siding tracks in traffic control territory.

To expedite train movements, bring about non-stop meets, and to permit better handling of long freight trains into and out of sidings, many roads are finding it practicable to install signaling on sidings and to provide signal indications that are less restrictive than formerly used.

Many installations in the past have been made in which the move into and through the siding has been under the "restricting" aspect, Standard Code Rule 290.

Some roads now install track circuits on the sidings and use the "slow-approach" aspect, Rule 288, or the "slow-clear" aspect, Rule 287, depending upon track occupancy.

Other roads have installed medium speed turnouts with track-circuited sidings and make use of the "medium-approach" aspect, Rule 286, or where extra long sidings are provided with intermediate signals thereon, the "medium-clear" aspect, Rule 283, is used, depending upon track occupancy.

Action Recommended

Acceptance as information.

NEW AND IMPROVED SIGNAL DEVICES AND
RELATED APPLIANCES†

It should be understood that this is solely a report to inform the members of the availability of the various devices mentioned therein, and what the manufacturers claim they will do. It is submitted as information—it does not constitute any Signal Section recommendation.

Multiple aspect cab signal system.

A new multiple aspect of cab signal system which may be used with d.c. half-wave rectified a.c. and a.c. coded track circuits has been developed. When a.c. coded track circuits are used, standard 60 cycle a.c. may be employed as the source of energy. It is not necessary to supply special frequencies such as 100 cycles. The same locomotive equipment serves for all applications and requires no switching or adjustment when changing from one type of coded track energy to another.

Additional benefits are:

1. Locomotive can operate over routes in which both a.c. and d.c. coded track circuits occur.

* Previous report on this subject appears in A.A.R. Signal Section 1949 Proceedings, Vol. XLVII, pp. 248 and 341.

† Previous report on this subject appears in A.A.R. Signal Section 1950 Proceedings, Vol. XLVIII, pp. 326 and 398.

2. Locomotive equipped with cab signal may be placed in operating pools regardless of the track energy used in the territory involved.

3. Railroads using d.c. coded track circuits to control wayside signals can utilize the same coding for cab signal control.

4. By using coded d.c. track circuits fed by primary battery, cab signals can be extended into areas where a.c. energy is not obtainable.

This is a development of the General Railway Signal Co.

Eight New Types of Devices

Plug-in type biased code following relay, Style PCD.

This is a compact rugged type of two-position biased code following plug-in relay. It is the plug-in equivalent of the standard shelf type Style CD code following relay both in electrical operation and maximum contacts available (four front and four back non-independent contacts). Numerous new design features are incorporated in this relay which makes for compactness, ruggedness, and ease of adjustment. This relay, like the Style CD, is trunnionless and free from wearing parts, which insures long trouble-free life.

The relay is $5\frac{1}{8}$ inches wide, 8 inches high, and $7\frac{1}{2}$ inches deep, with $1\frac{5}{8}$ inches additional depth taken up by the handle in the front.

This is a development of the Union Switch & Signal Div., Westinghouse Air Brake Co.

Plug-in type magnetic stick code following relay, Style PCDP.

This is a two-position magnetic stick code following plug-in relay. It is the equivalent plug-in of the standard shelf type Style CDP both in electrical operation and maximum available contacts (four normal and four reverse contacts). The same design features as the Style PCD relay, and the same size.

This is a development of the Union Switch & Signal Div., Westinghouse Air Brake Co.

Three-position shelf type code following relay, Style CDD.

This new type of code following relay is so arranged that one set of contacts (two normal front and back) will follow code of positive polarity only and another set of contacts (two reverse front and back) will follow code of negative polarity only. This relay is capable of following alternate pulses of positive and negative code so that both sets of contacts can be made to operate during a code frequency cycle. It is the same size and operates on the same power as the standard two-position Style CD relay. Like the CD relay it is of the trunnionless type and free from wearing parts which insures long trouble-free life. It can be furnished for either line or track operation. It may be used to obtain a multiplicity of indications over a single pair of line wires (four indications may be obtained over a single pair of line wires) from a single code frequency with a simple decoding arrangement. Additional indications can be obtained over a single pair of line wires by using additional code frequencies and frequency decoding.

This is a development of the Union Switch & Signal Div., Westinghouse Air Brake Co.

Style PD-20 code meter.

This is a portable multi-scale a.c.-d.c. meter which has been developed to meet practically all of the requirements in the railway signal field. It has a.c. voltage ranges from 2.5 to 250 with a full scale resistance of 1,000 ohms per volt, which makes it usable even on relatively high impedance circuits such as are encountered on line or carrier circuits. The d.c. voltage ranges are from 1 to 500 with a full scale resistance of 2,000 ohms per volt. The d.c. current ranges are from 0.010 to 25 amperes with reasonably low resistance so that the insertion of this meter will not appreciably affect the circuit characteristics. Numerous special features are incorporated, such as a needle stop for measuring peak values of code, and "on time" scale for measuring the percentage of time a contact is closed and special damping scales used for measuring rectifier currents.

This meter is a development of the Union Switch & Signal Div., Westinghouse Air Brake Co.

Biased neutral relay, Style PN-67B.

A new highly efficient plug-in biased neutral relay, Style PN-67B, has been developed as a decoding relay for coded wayside signaling systems. The relay uses a magnetic structure having two vertical coils in a case that is 50 per cent wider than the PN-50B relay. Contact equipment is 6F-6B dependent L.V.—calibration values are the same as the DN-11 four-point relay. The high operating efficiency of this relay is expected to be found useful in other applications.

This relay is a development of the Union Switch & Signal Div., Westinghouse Air Brake Co.

Slow pick-up biased neutral relay, Style PN-68B.

A new plug-in type of slow pick-up biased neutral line relay, Style PN-68B, has been developed. This relay is a slow pick-up ordinary drop-away type that is particularly suitable for use as a repeater of the track relay to overcome intermittent loss of shunt and "joint hopping" problems. Pick-up time is 1 second and drop-away time is 0.05 second at the normal rated voltage. Timing characteristics are similar to the shelf type Style DN-18 slow pick-up ordinary drop-away relay. It is the same size and carries the same contact equipment as the PN-67B.

This relay is a development of the Union Switch & Signal Div., Westinghouse Air Brake Co.

Biased neutral track relay, Style PN-50BH.

A new plug-in biased neutral track relay known as the PN-50BH relay has been developed for steady energy d.c. track circuit application. It is the plug-in equivalent of the well-known shelf type Style DN-22BH relay in calibration values and operating characteristics. This relay is the same size as the Style PN-50B (formerly the PN-50), but is equipped with a two-coil magnetic structure and 2F-2B independent L.V. contacts. The biased neutral feature, together with high drop-away ratio of this relay, results in the nearest practical approach to the ideal track relay for steady energy d.c. track circuits.

This relay is a development of the Union Switch & Signal Div., Westinghouse Air Brake Co.

Two-rate charge control unit, Style DNL-47.

A new two-rate charge control unit, designated DNL-47, is now available. This unit consists of a DNL-46 two-rate charge relay and an additional L relay mounted in a compact arrangement that requires no more shelf area than the DNL-46 relay only. The use of the additional L relay results in a reduction in battery drain in case of power failure and during trickle charge because the DNL-46 relay is disconnected from the battery under either of these conditions. The stand-by time of the battery is thereby increased.

This unit is a development of the Union Switch & Signal Div., Westinghouse Air Brake Co.

Automatic train identification and routing systems.

With these systems trains automatically register their destination and class as they pass selected wayside locations. The systems are designed for use at switching locations where traffic is heavy and trains follow each other at short intervals such as in rapid transit or commuting service. They make possible many new types of operation, one of which would be to enable a train to line up its own route without the attention of the interlocking operator.

The train-carried equipment consists only of a coil and tuning condenser, the coil being so mounted that it will be inductively coupled with the similar coil or coils on the wayside when it passes the wayside location.

The train loops are simple assemblies requiring no energy. Train identities can be changed readily by merely changing loops.

These systems are sensitive only to train loops and are not affected by masses of metal such as steel cars, wheels, etc.

Both the Union Switch & Signal Division of the Westinghouse Air Brake Co. and the General Railway Signal Co. have developed systems of this kind.

Solderless terminals.

A new method for attaching lead wires to relays and binding posts without the use of solder has been developed.

1. Pre-insulated solderless terminals.

This specialized AMP terminal is designed for intricate wiring systems where a flag type, body insulation, and end-on crimping are all advantageous. The installation can be completely made with one stroke of a precision tool. They are available in color-coded wire size ranges from No. 22 to No. 10.

2. Plasti-bond solderless terminals.

AMP's new design insures that no underlying conducting surface will be exposed even in case the outer plastic covering of this terminal should be pierced accidentally by faulty installation. This is accomplished by means of an isolated ring of copper bonded near the base of the insulation support sleeve. The ring gives all necessary strength to combat vibration and sharp bending, but does not communicate with the electrical connection farther up the barrel. Result is an insulated terminal that can be installed with one stroke of a tool.

These are developments of Aircraft-Marine Products, Inc.

Action Recommended

Acceptance as information.

COMMITTEE XI—ELECTRONICS

Personnel

J. I. Kirsch, Chairman

E. F. Brown, Vice-Chairman

A. B. Armistead	R. M. Laurenson
P. B. Burley	N. J. Morrisson, Jr.
T. L. Carlson	E. J. Muckerheide
J. R. DePriest	J. Ryscuck
L. H. Dyke	H. H. Seifert
H. T. Fleisher	V. O. Smeltzer
C. E. Hanert	T. B. Thompson
A. J. Hendry	T. W. Wigton
J. M. Hesser	A. V. Dasburg*
J. E. Hillig	C. B. Shields*
J. M. Hoover	F. H. Menagh*

Signal Section, A.A.R.:

The following outline of work has been assigned:

1. Revision of Manual.
2. Indexing signal literature.
3. Investigate and report on the use of electronic controls for railway signaling.
4. Report on electronic measuring apparatus applicable to railway signaling.
5. Principles of vacuum tubes, carrier systems and other electronic systems and devices.
6. Recommend basic design principles for electronic controls for railway signaling systems.
7. Investigate and report on the effects to both signal controls and communications when superimposing centralized traffic control circuits on existing dispatchers or other communication circuits, collaborating with Communications Section, A.A.R.
8. Electronic tubes for use in signal apparatus, recommendation to cover type and designations of tubes to meet various requirements.
9. Investigate and report on the use of electronic switches in lieu of electromagnetic relays.
10. Investigate and report on the attenuation of open wire pairs and of cable pairs at frequencies up to 75 kilocycles.

The Committee submits for consideration, reports on the following subjects**:

3. Train identification.

Electronic cut-off for pedestrian warning signal.

* Consulting Member.

** Suggestions or criticisms should be submitted in writing to the Chairman of the Committee on or before September 1, 1952.

4. Carrier level meter.
Line fault-finders.
 5. Considerations in the application of electronics.
 7. Mutual effects that may be encountered in combining circuits on a single pair of wires.
 10. Attenuation of open wire pairs and of cable pairs at frequencies up to 100 kilocycles.
- Cooperative report. Communications Section, A.A.R., Committee 4—Radio and Allied Communications.

MUTUAL EFFECTS THAT MAY BE ENCOUNTERED IN COMBINING CIRCUITS ON A SINGLE PAIR OF WIRES

Under certain conditions it may be feasible and desirable to combine communication and signal control and indication circuits on the same pair of wires. As there are many known ways of combining circuits on a single pair of wires, and undoubtedly a great many yet undiscovered ways, it will not be the purpose of this report to describe the combinations that might be used but rather to point out the mutual effects that are likely to be encountered so that design problems may be anticipated.

When planning circuit combinations the following factors should be given consideration:

1. *Crosstalk.*

(a) Coordination of frequencies by direction of transmission. Allocations of frequencies by direction of transmission should be in accordance with recommendation of A.A.R. Communications Section 2-J-46.

(b) Coordination of energy levels. High level circuits are liable to crosstalk into low level circuits. In general, circuits having somewhat similar energy levels and attenuation characteristics will produce a minimum of mutual interference.

(c) Quality of filters. Filters, if used, must have low attenuation to wanted frequencies and high attenuation to unwanted frequencies.

(d) Adequate separation of frequencies. Frequencies should be chosen so as not to place unreasonable requirements on filters.

(e) Interference from harmonics. Frequencies should preferably be such that no circuit operates at a frequency that is an exact multiple of the frequency of another circuit on the same line.

(f) Saturation of loading coils. Loaded cables should not handle currents in excess of the rating of the loading coils. Excessive current may cause saturation of the coil cores with resultant crosstalk.

(g) Interference from, or to, ringing devices. The use of ringing equipment including selectors and answer-backs, may introduce problems on circuits that would otherwise be free from crosstalk.

2. *Energy levels.*

(a) Equipment losses. The connecting of equipment for an added circuit normally increases attenuation of the original circuit. These losses may be severe enough that compensation of some kind is required.

2. *Energy levels.*—Continued.

(b) Impedance mismatches.

1. Source and load impedances must be essentially equal for all circuits on the line to prevent one circuit from draining excessive energy from another.

2. Intermediate devices such as filters, by-pass, and transfer equipment must be of substantially correct impedance.

3. Line discontinuities may introduce negligible losses in some circuits while producing appreciable losses in other circuits on the same line.

4. Branch lines, taps, or loops may add considerable loss to some circuits without introducing appreciable loss in others.

(c) Individual circuit termination. Devices used to terminate one circuit and continue another should introduce a minimum of attenuation in the continuing circuit.

(d) Repeater location. It is sometimes necessary to repeat one circuit on a line without repeating other circuits. A single repeater should theoretically be located at the electrical center of the circuit for maximum usable gain, but such a location may be highly undesirable in its effect on the other circuits. Before choosing a location for a repeater, full consideration should be given to the resultant effect upon all circuits on the line.

(e) Avoidance of critical energy levels. Circuits operating with ample margins may have these margins brought close to the vanishing point when an additional circuit is placed on the line. Under these conditions the fact that the original circuit continues to operate should not be accepted as evidence of satisfactory design.

3. *External interference.*

(a) Loss of balance. Equipment which is sufficiently well balanced for some circuits may be inadequate for other circuits on the same line, and may permit the introduction of external interference into the original circuit.

(b) Grounds. Addition of grounds for simplex circuits, composites, or drainage coils may introduce interference on one circuit without interfering with other circuits on the same line.

(c) Branch lines. The addition of branches, taps, or loops made necessary by additional circuits may add interference to existing circuits.

4. *Intermittent conditions.*

(a) Way station telephones. Intermittent use of way station telephones may cause varying attenuation on both the telephone circuit and on other circuits on the same line.

(b) Portable telephones. The possibility of portable telephones being connected to the line and the resulting bridging losses should be considered for each circuit on the line.

(c) Branch lines not continuously connected. Branch lines are sometimes patched to through lines for the duration of conversation. The connection may be made by an operator at the junction point or may be controlled remotely by selectors or other equipment. Unless properly designed such patches may introduce excessive attenuation to one or more of the circuits.

(d) Maintenance work. Lines known to have frequent outages are normally

4. *Intermittent conditions.*—Continued.

not desirable for handling multiple circuits because the total circuit outage time increases proportionately to the number of circuits on the line. Frequent maintenance work on equipment of one circuit may adversely affect other circuits on the line.

(e) Normally-off repeaters. Circuits are sometimes provided with stand-by repeaters arranged to be cut in under excessive attenuation conditions. With such an arrangement the effect on all circuits should be checked with repeater both in and out.

(f) Weather conditions. Long open wire lines are subject to wide variation of attenuation with changing weather conditions. Lines that are satisfactory for certain types of circuits under all weather conditions may be totally unsuited to other types of circuits under the same conditions.

(g) Patching to fall-back lines. Lines carrying multiple circuits are sometimes chosen because they are particularly suited to that use, or are treated to make them suitable. If it is contemplated that paralleling lines, or lines on alternate routes, are to be available as fall-back lines, it should be determined in advance that the alternate lines are capable of handling all the circuits on the normal line. Unless this is done it may be found that in emergencies the most important circuits are lost while less important ones remain in service.

5. *Operating characteristics.*

(a) Disadvantages of multiple-circuit lines.

1. The possibility of a circuit failure due to a line fault is greater on multiple circuit line than on a single circuit line.
2. Certain circuit combinations require time sequence or sharing for their operation.
3. At present there is no known way to eliminate interference caused from simultaneous operation of circuits, such as centralized traffic control code and field ringing.
4. Addition of equipment to a line normally increases liability of failure to both original and added circuits.

(b) Advantages of multiple-circuit lines.

1. Economy. Combining circuits often shows such marked installation and maintenance savings that a considerable amount of engineering can be justified if necessary to produce a satisfactory over-all design.
2. Fault detection. Addition of a second circuit to a line may be helpful in detecting a line fault that might otherwise continue unnoticed. This detection may be the result of the added circuit being more readily influenced by the particular type of fault, or by the second circuit being more frequently monitored. Such fault detection may permit clearing the trouble before failure actually occurs.
3. Reliability. Where a new line is required or an existing line is to be rebuilt, increased reliability might be obtained by consolidating several circuits on one strong line rather than using several weaker lines.

Action Recommended

Acceptance as information.

ATTENUATION OF OPEN WIRE PAIRS AND OF CABLE PAIRS
AT FREQUENCIES UP TO 100 KILOCYCLES

Tabulated attenuation data for open wire and cable pairs are available in a Federal Telephone and Radio Corporation publication, "Reference Data for Radio Engineers," Third Edition. These data have been plotted in curve form to show attenuation at frequencies up to 100 kilocycles for typical physical conditions. The curves for open wire pairs of copper and copperweld wire in wet and dry weather are shown in Figs. 1, 2, 3 and 4. Those for toll cable are shown in Fig. 5. (See pages 308 to 312.)

Differences may appear to exist between these and other published data. However, such discrepancies can generally be explained by the fact that the data are derived from different physical conditions. The attenuation varies as a function of poles per mile, pin spacing, type of insulator, temperature, etc. Therefore these must be defined for each set of attenuation tables or curves.

Some information on attenuation of steel and iron open wire pairs is available; however, it has not been included in this report because the conditions under which it was obtained are not adequately defined. A general statement can be made that attenuation for iron and steel wire is from ten to twelve times that for equivalent copper wire at frequencies between 3 and 50 kilocycles.

Action Recommended

Acceptance as information.

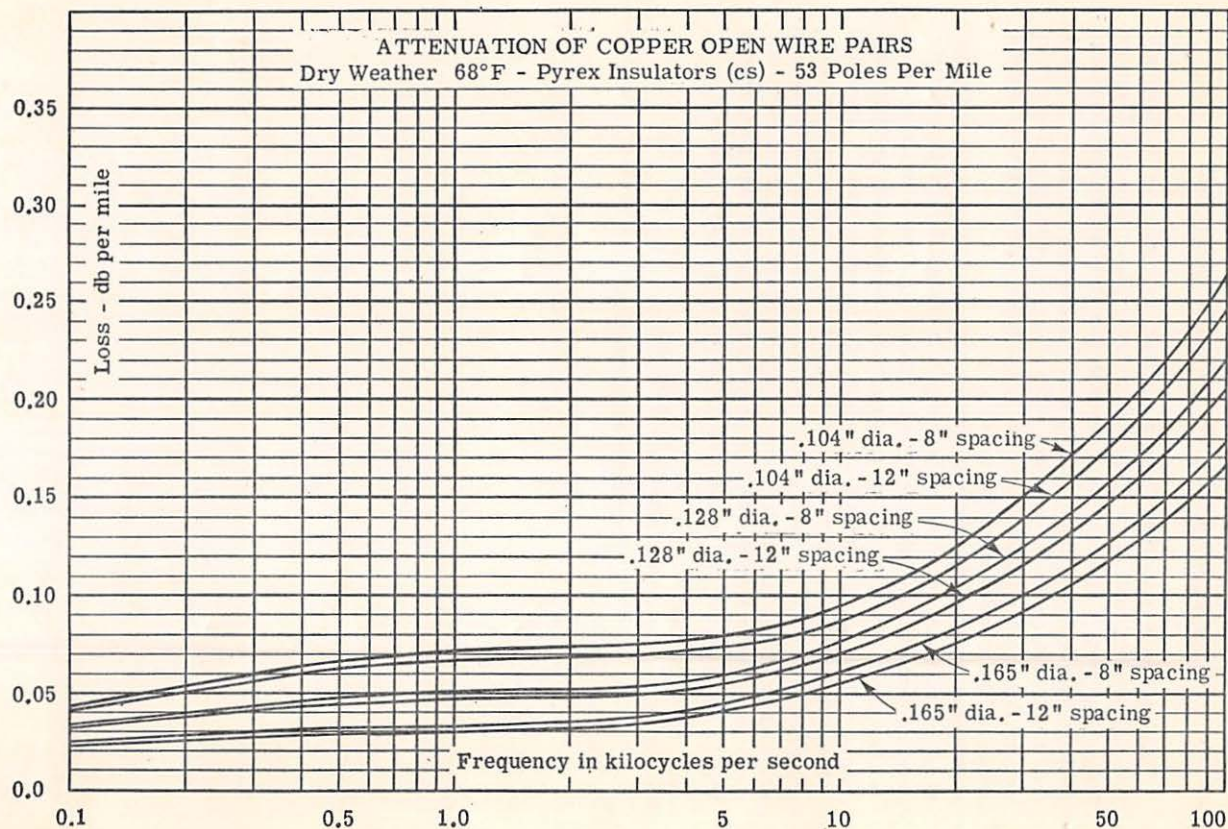


Fig. 1.

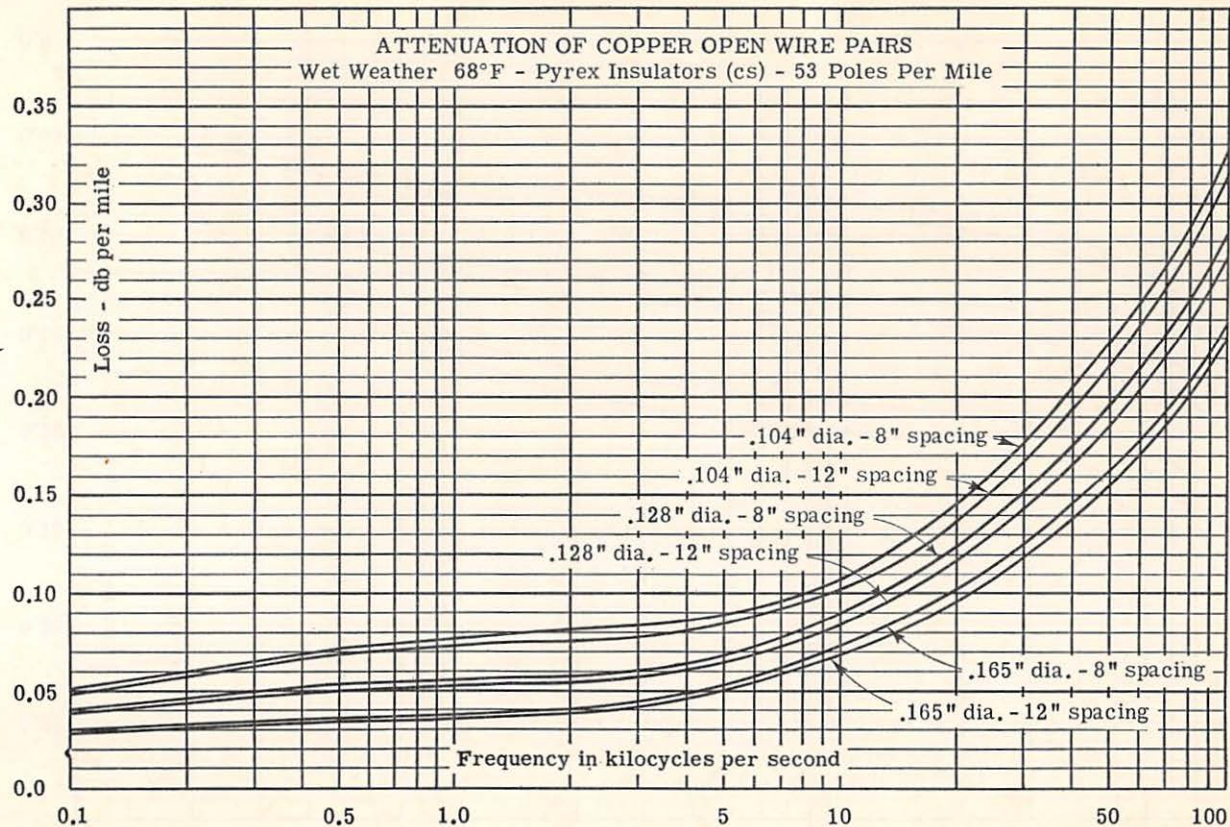


Fig. 2.

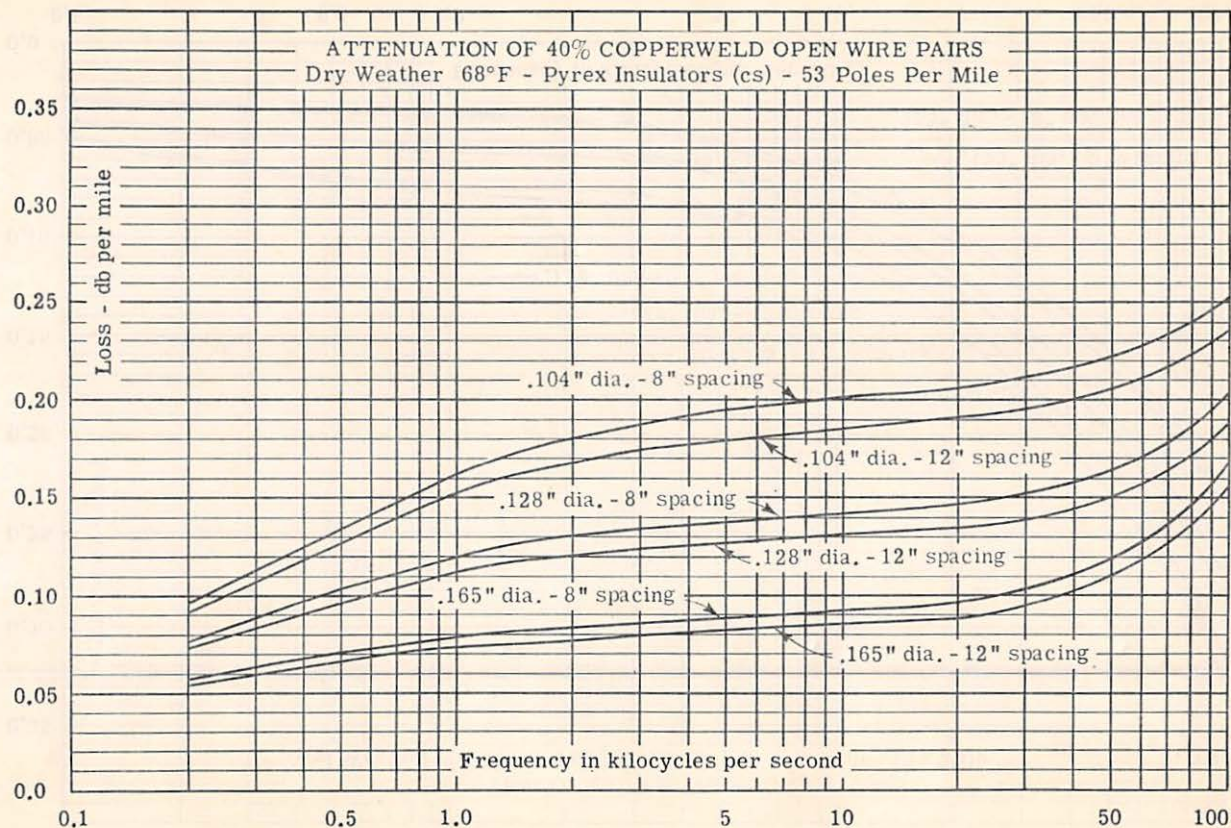


Fig. 3.

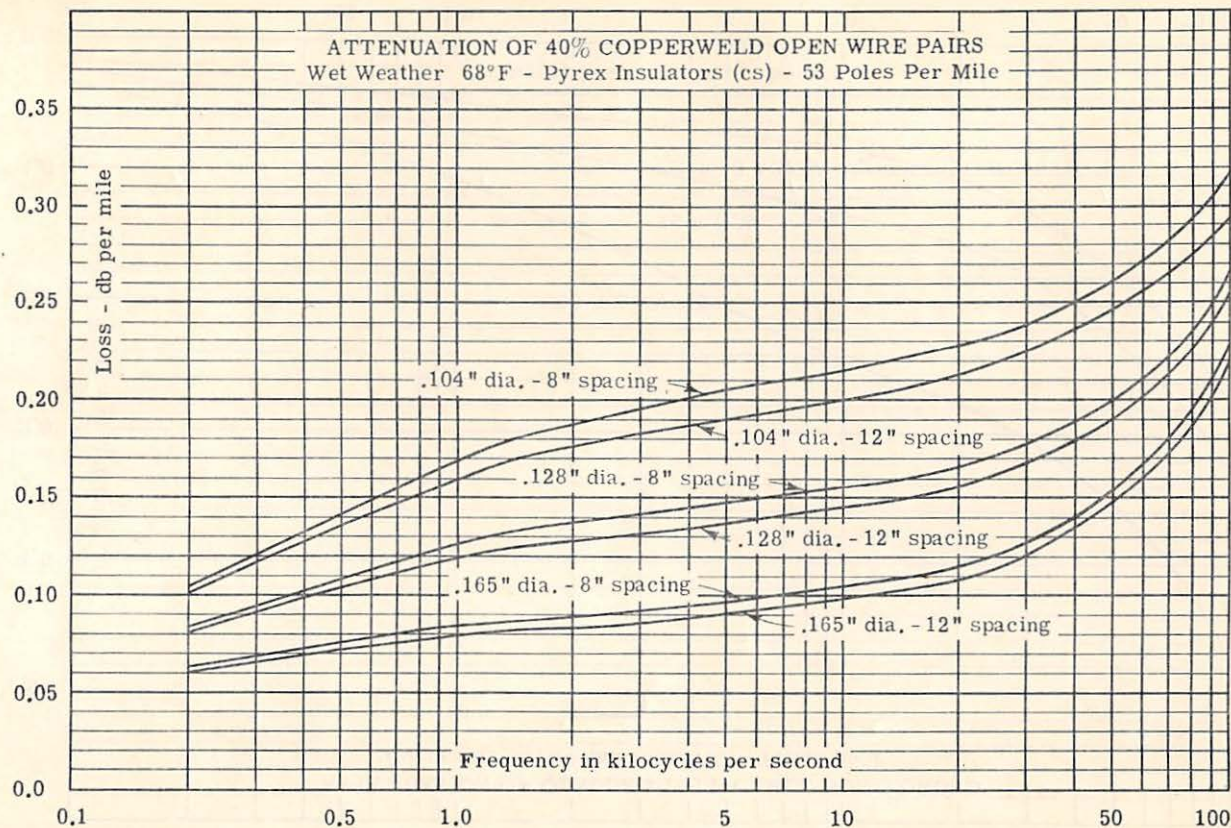


Fig. 4.

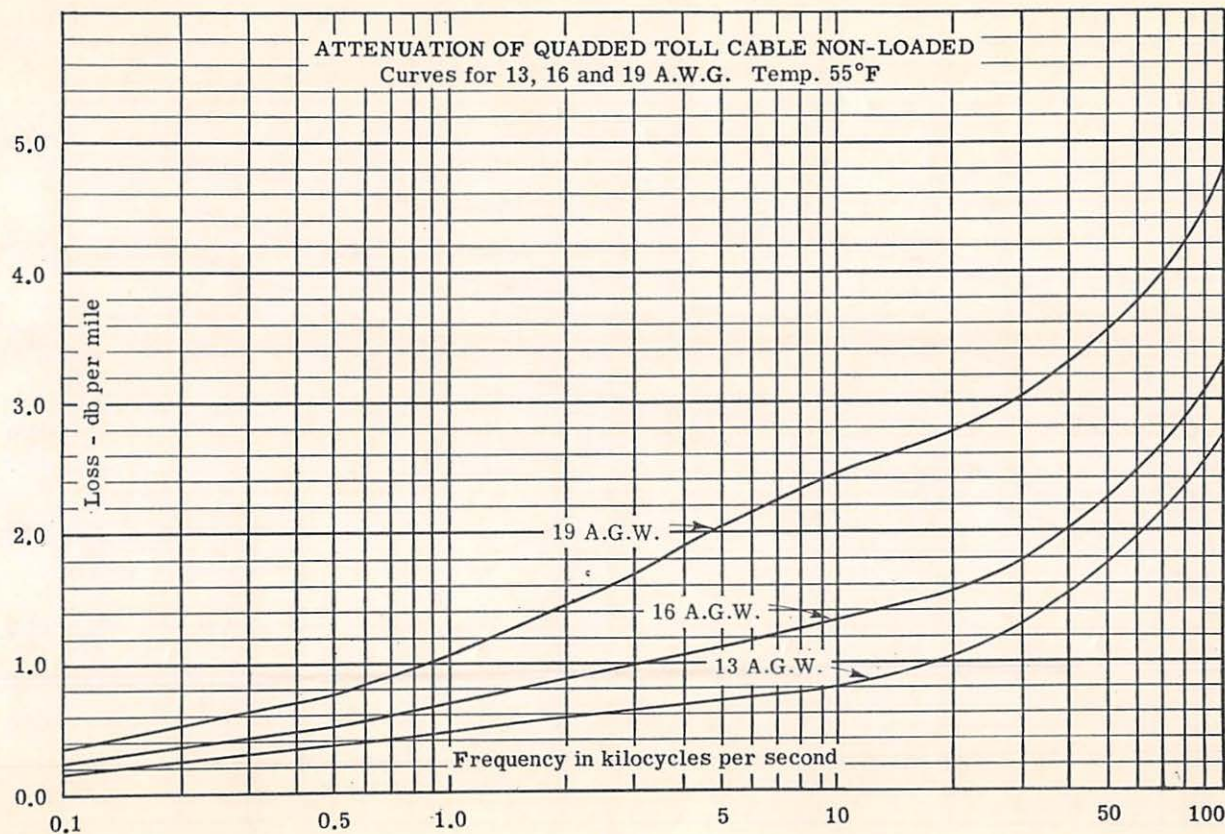


Fig. 5.

TRAIN IDENTIFICATION

Two systems for automatic train identification employing electronic controls have been recently developed. A description of these two systems is as follows:

Automatic train identification and routing system.

There are, on practically all railroads, locations at which trains must be switched to one or another of diverging routes. In order for an operator to line up the proper routes for such trains, he must, of course, know the identity of each train and its intended destination. On rapid transit lines, and on railroads operating commuter trains, this matter of train identification and routing can present a real problem, because traffic is heavy and trains follow each other at short intervals. An operator who has to identify such trains by means of their marker lights, by telephone messages, or by other means, and who must then set up the proper route for each, may find it difficult to keep up with the flow of traffic. It may happen, therefore, that delays occur in lining up routes and even, occasionally, that trains get misrouted giving rise to serious delays. To aid in the solution of this problem, an automatic train identification and routing system has been developed by which each train identifies itself and lines up its own route without the attention of the operator.

The system identifies trains by means of the effect of train-carried loops on a vacuum tube oscillator whose frequency is varied at a rapid rate over the approximate range of 100 to 300 kilocycles. The oscillator and related circuit elements are installed at a wayside location in advance of the first switch of the interlocking. One of the circuit elements included in this arrangement is a track coil of approximately 15-inch diameter, mounted between the rails, and excited with the variable-frequency output of the oscillator. Each train to be identified carries a tuned loop mounted underneath the locomotive or leading car. The resonant frequency of this loop identifies the train, and is of such value as to lie within the range of frequencies covered by the variable-frequency oscillator. As the train moves over the identification point, the train coil is momentarily coupled to the track coil, and produces a reaction in the oscillator circuits because of the energy transfer which takes place between the track and train coils.

The oscillator reaction is not, however, continuous during the entire time the train coil is passing over the track coil, since appreciable energy transfer between the wayside and train circuits occurs only when the rapidly varying oscillator frequency is in the immediate vicinity of the train-coil frequency. But at this frequency, the oscillator reaction is marked, even when the train coil and track coil are separated by the nominal clearance distance of 15 inches.

By means of suitable circuits, the oscillator reaction is used to develop a momentary pulse which is applied simultaneously to a group of relay control channels. These channels are arranged to remain cut off unless a gating voltage is also present. The gate is derived from a group of resonant circuits tuned to the same frequencies as the various train coils. Each of these resonant circuits causes the appearance of a gate as the oscillator moves past its frequency.

Each frequency-determining gate is applied individually to the particular relay-control channel associated with that frequency. A coincidence arrange-

ment is thus set up by which the appearance of an oscillator-reaction pulse on all relay control channels indicates the presence of a train loop, and the simultaneous appearance of a frequency-determining gate on one, and only one, of the relay-control channels identifies the frequency of the loop. The channel which receives both oscillator-reaction pulse and frequency-determining gate thereupon picks up an associated relay to identify the frequency of the passing train loop, and this information is then utilized by means of suitable circuits to line up the proper route for the train.

The circuits used to develop the oscillator-reaction pulse are so designed as to produce output only when the oscillator reaction is of an abrupt nature. This type of reaction is characteristically produced by resonant-circuits of sufficiently high Q (low loss), such as the train loops, but is not produced by random conducting objects. As a result, the wayside circuits do not respond to the passage of stray metallic objects, steel cars, wheels, drive motors, etc., which may pass by or over the track coil, even though such objects may be of considerable size, and be associated with magnetic fields of appreciable magnitude.

By using a four-frequency system (*i.e.*, four different frequencies for train loops with corresponding wayside frequency identification arrangements) combination of one or more train loops may be used to provide as many as 14 distinct identifications. The train identification features of the system may also be combined with route-storage circuits, so that the route for a number of trains may be stored and then fed out to route selection circuits as each train reaches the first switch in the interlocking. The circuits can also be arranged to actuate a wayside annunciator so that the engineman can see that his train has been correctly identified.

Some of the more important features of the system are summarized as follows:

1. Train loops are simple, economical assemblies requiring no energy. Train identities may be changed by exchange of loops.
2. Only one oscillator and one wayside coil are required for any practical number of frequencies. Use of sweep-frequency principle eliminates need for separate oscillators for each frequency.
3. Sweep-frequency operation eliminates need for oscillator stability required with a fixed-oscillator system. All frequency-identifying circuits are passive resonant circuits, inherently stable.
4. The system is sensitive only to tuned train loops, and operation is not affected by even large metallic masses, such as steel cars, wheels, etc.
5. Speed of identification is sufficiently great to provide positive identification of fastest moving trains.

Inductive train identification system.

With this system, trains automatically register their destination and class as they pass selected wayside locations. The system was developed primarily for service where trains operate on close headway as in rapid transit or commuting service to provide means for indicating the destination of approaching trains to the operators at interlockings and, in conjunction with illuminated signs or an automatic announcing system, to the public at station platforms. The system can also be used to provide automatic routing by using it in com-

ination with the principles of route interlocking. The train identification system also provides a facility that is needed in the application of remote control to rapid transit signaling.

The train-carried equipment consists only of a coil and tuning condenser, the coil being so mounted that it will be inductively coupled with the similar coils on the wayside when it passes the wayside location. The coils have a diameter of approximately 10 to 18 inches depending on the mounting arrangement on the train and the separation distance from the wayside coils. For multiple-unit type of trains, the coil and tuning condenser are arranged as a quickly detachable unit held in a bracket on the front car. The coil unit is quickly replaced by one of a different tuned frequency when it is desired to change the identification. An important advantage of this type of inductive system is that it does not require any electrical connections or source of energy on the train.

At each wayside location where trains are to be identified, a pair of coils similar to those on the train and in a fixed relationship to each other are mounted alongside the track. One of these coils is the transmitting coil that sets up the high frequency magnetic field in its vicinity and the other coil serves as a pick-up or receiving coil. For each identity to be registered at the location, there is an electronic unit consisting of a small conventional vacuum tube oscillator that generates the high frequency current applied to the transmitting coil, and an amplifier, thyatron tube, and relay, which operate in response to voltage of that same frequency in the receiver coil. Oscillator-amplifier units of several different frequencies operate in parallel on the same pair of wayside coils. The receiver coil is positioned so as not to have any appreciable coupling with the transmitter coil normally but when a tuned coil on a train is opposite the wayside coils, the coupling from wayside to train coil and back from the tuned train coil to the wayside receiver coil induces a voltage that is amplified and causes the thyatron to conduct and pick up the relay.

The amplifier system includes a phase discriminator circuit in which the voltage from the receiver coil is compared in phase with that from the oscillator. This discriminator circuit is so adjusted that the tuned coil produces a positive output voltage but a mass of metal such as the side of a car produces zero or negative output voltage and thus will not cause the thyatron to become conductive. This arrangement provides immunity to false tripping by a mass of metal and in combination with selectivity of the amplifier prevents tripping by a coil of another tuned frequency, even with considerable variation in separation distance caused by sway of the cars. This detecting system also has good immunity to stray magnetic fields such as are caused by surges and ripples in the propulsion current on electrified railroads.

The oscillator-amplifier units and the associated relays are designed as panel units arranged for quick-detachable mounting on a rack, with plug connectors for the electrical circuits. The panels are narrow so as to fit in the narrow type of signal cases commonly used in subway signaling. The rack can be suspended in the case by rubber shock mounts when required. Each oscillator-amplifier unit is mounted on a separate panel strip and each identification frequency operates independently of the others so that in case of trouble such as a tube failure, only the one identification is affected and it is very simple to locate the defective unit and restore it to service with a minimum of delay.

The equipment will respond properly for any train speed and will operate only once for a train even if it should stop exactly at the identification point. The relay circuit is arranged to restore itself automatically in a predetermined short time after passage of the train or if desired can be reset by means of a push button.

There is no appreciable radiation from the transmitting coil at the frequencies used, approximately 50 to 200 kilocycles, and consequently there is no interference with other equipment or with identification of trains on adjacent tracks. The induction field becomes negligibly small at distances from the transmitting coil more than two or three times its diameter.

Action Recommended

Acceptance as information.

ELECTRONIC CUT-OFF FOR PEDESTRIAN WARNING SIGNAL

One of the Eastern roads with heavy commuter traffic provided warning at pedestrian crossings at stations where passengers cross main tracks to the opposite platform, by the installation of vertically mounted flashing light units attached to the intertrack fence at the gate for the pedestrian crossing. The flashing light units are operative for the approach of a train and inoperative when the rear end of the train has passed the pedestrian crossing. Where existing track circuits were properly located they were used; however, where they were not properly located an electronic cut-off was developed to offset the necessity for further cutting the track circuits, the cost of which is prohibitive in electrified territory when a warning of this type is being considered.

The electronic cut-off, which is superimposed on the existing alternating current track circuit, requires the track circuit potential to be applied at the entering end of the circuit. Sensitivity (detection of a small potential at the cut-off point in the track) is obtained by the use of a four-electrode thyatron of the indirectly heated cathode type designed for relay applications (Type 2D21), having two terminals for the series shield grid connection. The operation of the device is as follows:

Referring to Fig. 1, when a shunt is applied to the rails at the entering end of the track circuit the track relay, or its repeater, releases and applies a potential to the input winding of transformer T1 and also closes the circuit from the rails to the input winding of grid transformer T2. However, due to the train shunt there is zero voltage across the input of transformer T2 and the thyatron tube does not conduct. After the rear wheels of the last car have passed the point where the grid transformer T2 is connected to the rails a potential obtains across the input winding of the transformer T2 which is stepped up and applied to the control grid of the thyatron to initiate conduction. While the tube is conducting, the cut-off relay is energized by a current from minus 150-volt secondary of transformer T1, through shield grid 7-5, terminal A of potentiometer R6, resistor R5, to cathode-anode of thyatron, through winding of cut-off relay and resistor R1 to plus 150-volt terminal of transformer T1. Since the tube does not conduct during the negative half cycle, release of the cut-off relay is retarded by condenser C1 and resistor R2. The relay, being in series with the shield grid, will not operate if the shield grid opens. When the train shunt is entirely removed from the track circuit the track relay picks up and the device is de-energized.

Adjustment is made by using the potentiometer R6 to adjust the shield grid potential; resistor R5 provides for a minimum negative bias. Resistor R4 is provided to obtain the desired grid voltage at the time of installation.

In this application proper phasing is accomplished by using the instantaneous polarities of the several transformer windings, the transformers all being connected to the same single-phase source, thereby avoiding too critical tube operation or the use of additional components to obtain proper phasing. Thus, in the positive half of the a.c. cycle the anode and control grid are both positive when the shield grid is negative, and in the negative half of the cycle they are both negative when the shield grid is positive.

In the period of the 2½ years that the devices have been in service, the cut-off points have not varied more than 25 feet, within the ranges of ballast resistance which have been experienced.

Action Recommended
Acceptance as information.

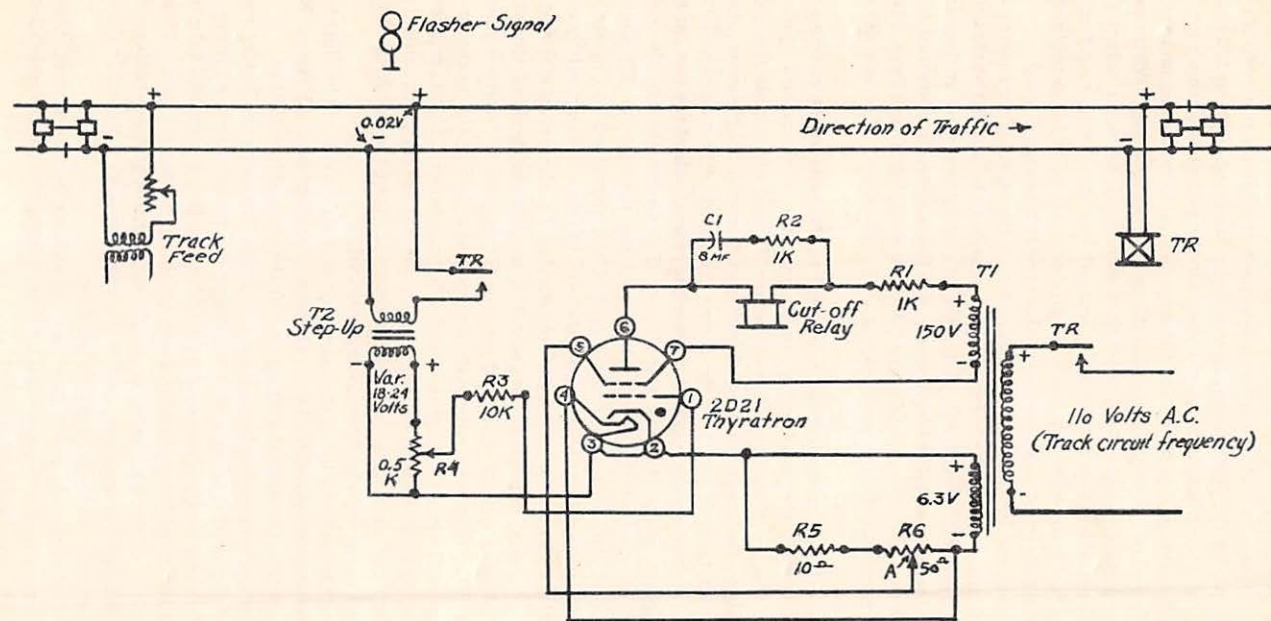


Fig. 1.
Electronic Cut-Off Circuit.

CONSIDERATIONS IN THE APPLICATION OF ELECTRONICS

Electronics is defined by the Signal Section, A.A.R., as that branch of science and technology which relates to the conduction of electricity through gases or in vacuo. Although the science of electronics has developed rapidly in recent years, it is all too often considered to be the ideal solution to the problems of signal control and transmission of intelligence. The heart of such systems is the electron tube which, when combined with the proper components of resistance, capacitance and inductance, serves to accomplish many functions not otherwise attainable. Although the electron tube has risen to a remarkable height of development wherein it is now irreplaceable in many of its functions it is still possessed of certain undesirable qualities.

Applications.

In considering the application of electron tubes for use in signal apparatus, certain advantages and disadvantages in their use should be recognized. Electronic techniques offer high versatility, accuracy, extremely high speed and efficiency. Electronic controls are easily obtainable, having sensitivities far greater than other means of control. Electronic means are especially useful for amplifying weak signals, responding to signals of too short duration for relays, performing highly repetitive relaying and power switching operations beyond the mechanical life of relays and contactors, and responding to optical conditions.

The attributes of electronic systems may be set forth as follows:

Speed of response is high.

Unlimited number of gradation steps of control are available.

Systems can be remotely controlled over great distance.

Time, force, displacement, and positional information can be converted readily to signal variations and vice versa.

Centralization of complex controls and indications can often be achieved more economically than by other means.

Special functions may be performed, such as addition, multiplication, or subtraction with different weighting factors for each variable if desired.

Electron tubes will respond at lower energy levels than other devices used to perform control functions.

Current may be controlled without opening or closing the circuit.

Coupled with the advantages of electronic systems are certain distinct disadvantages which may be outlined as follows:

The electron tube, upon which the functioning of the system depends, has shorter life and generally is far less reliable than its associated components.

Specially skilled maintenance personnel are required.

Specific problems.

In arriving at a decision on any control system the factors of performance, reliability and costs of installation and maintenance must be carefully weighed; each bearing its proper relation to the result desired. Such planning cannot be

limited to the controls only, it must also be extended to the problem from a system point of view. In considering applications in railway signaling where human life, valuable tonnage, and costly equipment must be fully protected, reliability becomes of paramount importance. It is here that the electron tube, while possessing many very desirable characteristics, must be viewed with distinct criticism for its failure to have matured as a reliable component. All other elements of the electronic system, the capacitors, resistors, inductances and transformers, are generally more dependable than the very heart of the system—the electron tube. Many factors contribute to the deficiency of the electron tube. Principal of these are faults of the cathode or electron emitter, the vacuum tightness, the gas content, grid emission, and mechanical design.

Cathodes.

Every tube has a cathode of some kind whose duty is to emit electrons and many premature tube failures are caused by cathode failure. Except for pure metal filaments, most cathodes are complicated composite materials, such as oxide coatings deposited on metal cores; or they can be some form of metal impregnated with other materials, as, for example, thoriated tungsten. Their operation depends on a fine balance between diffusing a sufficient amount of emissive material to the surface as opposed to evaporating too much of the emissive material. Cathodes are sensitive to contamination by minute impurities, which can come from elements of the tube, from the glass or from chemicals that have been used to clean tube parts. These composite cathodes must be operated near their rated temperatures in order to obtain satisfactory operation.

Vacuum tightness.

All electron tubes must be essentially vacuum tight in order to continue operation. In the manufacturing of tubes many are rejected at inspection because the vacuum is not sufficiently perfect. Undoubtedly a certain number of tubes are shipped that leak so slowly as to defy detection. Those tubes that are called "vacuum-tight" simply leak so slowly that they may last for many years without becoming too gassy to function properly.

Gas content.

In electron tubes, two actions occur: namely, the gradual evolution of gas from certain metal parts due to temperature and electron bombardment, and the gradual absorption or clean-up of gas by other surfaces in the tube.

In the high-vacuum type of tube, it is fortunate that this gas clean-up action exists. Without it, large high-vacuum power tubes might not be practical. Here, the satisfactory maintenance of high vacuum depends in part upon the action of gas clean-up by certain electrodes keeping pace with the gas evolution from other electrodes. Fortunately, in this case there cannot be too much gas clean-up, since the better the vacuum the better the condition. Failure from this cause results only when gas evolution exceeds gas clean-up. In gas-filled thyatron, which depend upon the maintenance of a specific gas pressure throughout their operating life, this balance is more delicate and even with the best known techniques, gas clean-up eventually develops too low a gas pressure for satisfactory operation and the tube ceases to function.

Sept. 1952]

Grid emission.

Many tubes, such as triodes, tetrodes, and thyatrons, have grids that control the current between cathode and anode. For the control characteristics of the tube to remain constant, the primary emission (due to temperature), the secondary emission (due to electron bombardment), and the current collected or intercepted by the grid must all remain constant throughout the life of the tube. Both the primary and secondary emissions are sensitive to minute traces of impurities deposited on the grid metal. Since cathodes invariably vaporize a certain amount of active material, a grid material must be used that remains constant in its characteristics regardless of contaminations.

Mechanical design.

In the manufacture of electron tubes, as in radio receivers for example, many connections or joints must be made by either welding, soldering, brazing, riveting or clamping. If a connection fails in a receiver it can be repaired. If it happens within a tube it cannot be repaired and the tube must be scrapped. Making reliable connections is complicated by the necessity of using and joining widely dissimilar materials that operate at widely differing temperatures. The choice of joining methods is further limited by the necessity of avoiding any flux or other material that will cause the tube to become gassy, or any material that will evaporate at operating temperatures causing contamination of other tube parts or leakage over insulators.

Another common factor in all tube designs is the problem of insulating the various elements of the tube from one another. These insulating sections may be glass, mica or ceramic. In most cases they form all or a part of the vacuum-tight envelope and also become a part of the mechanical support for the tube elements. Both glass and ceramic materials are brittle, will withstand only a limited thermal shock, and generally do not form a perfect union with the metals to which they must be sealed. The insulating sections should be long to improve insulation and short to improve mechanical strength. The design, therefore, is a compromise between these two requirements and is a balance between insulating reliability and mechanical ruggedness. The insulating material must be vacuum-tight, relatively free of gas content or easily out-gassed, and must have a temperature coefficient of expansion, matching as closely as possible one of the metals to which it is joined. The choice of insulating material is further limited by the fact that it must be suitable for forming vacuum-tight seals.

The function of an electron tube is vitally dependent upon the geometry of the element structure. Spacings of grid wires frequently must be held to tolerances of the order of plus or minus 0.0005 inch. It is necessary that precise dimensions be maintained when the tube is subjected to long periods of vibration, and mechanical and thermal shock.

These are the principal factors contributing to the reliability or unreliability of electron tubes. Intensive research and engineering development will be required to bring about their satisfactory improvement.

Reliability in electronics.

Probably electron tubes depend for their operation on a greater number of little understood factors than any other product in mass production. Tube manufacturers and industrial users, being cognizant of this fact, have under-

taken extensive development programs directed at ruggedizing and refining electron tubes for industrial application.

The commercial airlines, faced with operating conditions very similar to those of the railroads, have initiated a thorough redesign of the tubes they require. Actual development work is being performed by several tube manufacturers and coordinated by Aeronautical Radio Incorporated, the airlines communications agency. The miniature tubes are very well suited to the airlines requirements of weight and space and a program for the development of reliable long-life types of miniature tubes was instituted for ten tubes.

The types of ruggedized long-life and the original versions are as follows:

Tube	Ruggedized	Type Number	Prototype
Pentode.....	5654		6AK5W
Twin Triode.....	5670		2C51
Double Diode.....	5726		6AL5
Pentode.....	5725		6AS6
Pentode.....	5749		6BA6
Pentode.....	5686		None (new tube)
Hi-Mu Twin Triode.....	5751 (Z 1764)		12AX7
Pentagrid Converter.....	5750		6BE6
Medium-Mu Twin Triode.....	5814		12AU7
Thyratron.....	5727		2D21

Under this program, the airlines return to the manufacturer all defective tubes with complete service data showing hours of service, equipment in which they were used, and the function for which they were employed. The defective tubes are analyzed by the manufacturer and remedial measures are introduced in the manufacture to eliminate the cause of failure. Industry-wide savings in the first year of this reliable tube program have been estimated to be \$100,000 in tube replacement alone. Reductions in maintenance costs and mechanic's time in handling and servicing equipments and records account for an additional \$150,000, giving a total of a quarter-million dollars saved in the first year.

The National Bureau of Standards Electron Tube Laboratory is investigating all aspects of electron tube ruggedization. They are making a survey of the actual operating conditions for tubes in various kinds of commercial, industrial, and military apparatus. Test equipment is now in operation to study the effects of vibration, mechanical resonance, high-impact shock, and high-speed centrifugal forces. Tubes are examined after ruggedness tests for structural failures. X-rays are frequently employed to reveal the extent of structural changes without opening the tube envelope. Materials for certain tube elements are examined spectroscopically to determine their exact composition and to find impurities that might weaken the tube structure. From these studies come recommended specifications for materials best suited to particular applications.

Many of the electron tube manufacturers have had accelerated development programs in operation for some time, endeavoring to produce suitable ruggedized or reliable tubes. As a result, a number of redesigned tubes have been offered for commercial and military use which have proved to be of superior quality. Nevertheless, all concerned with the problem continue to give full

recognition to the need for much greater improvements than have yet been obtained before the electron tube can, in general, assume its proper place in industry.

Many field troubles with electron tubes fall in one or more of the following categories:

- The use of tubes when some other device would be more suitable.
- Failure to select the proper tube for the job.
- Failure to operate the tube at or below its ratings.
- Actual engineering errors in the design of the circuit.
- Failure to incorporate adequate protective devices in the system.

Reliability must be designed into the electronic system. In making applications in railway signaling the "fail-safe" or closed circuit principle must not be compromised and designs must be such that any conceivable tube fault results in a "safe" failure.

Tubes, of course, eventually fail and in the long run the rate of failure follows the usual probability curve. Most failures occur close to the average life expectancy but a certain percentage of failures occur before or after that time, some tubes failing quite early in life. This characteristic has been rather carefully investigated by one of the tube makers wherein the statistical evaluation of tube life expectancy has been demonstrated to show promise as a means for predicting the life of a specific run of tubes from the production line. The procedure involves a 500-hour life test on a sample lot to which statistical methods are then applied to predict the life curve of the entire run. Further development of the procedure may offer the tube maker a means for stating conservative tube life of the reliable types. Procedures have also been developed whereby initial run-in tests can be made which reduce the number of early failures.

Probably the greatest threat to reliability in electronic equipment is the continual pressure from users and equipment designers to increase the ratings. Such a trend is completely contrary to the desire for greater reliability. The telephone systems obtain long life and maximum reliability by operating tubes below their ratings. Until better tubes are available, the same should hold for industrial apparatus.

Often, laboratory tests must be made to determine if tubes are actually being used within ratings. Another common occurrence is that two or more tubes operated in parallel do not divide the load properly, so that one tube becomes overloaded while the other is underloaded. This is especially likely to happen with gas-filled tubes, which do not operate properly in parallel unless specific means are provided in the circuit for this purpose.

Considerable benefit can be gained by operating tubes below their ratings, and by actual tests to prove that conditions in a circuit are as they appear to be. Complete tests on finished models with oscillograms to show transient conditions will also detect many design errors that would otherwise go unnoticed.

Inadequate protective devices are often a costly factor. Tubes do not, as a general rule, have the factor of safety inherent in other components, so the omission of an adequate protective device may result in the tube being destroyed or damaged when a fault occurs in the circuit.

Another frequent cause of trouble is the failure of the equipment designer to

take into account the extent to which characteristics vary from tube to tube and during the life of the tube.

Of course, all such careful and painstaking measures on the part of the tube manufacturer tend to increase the cost of a tube many times over that of the ordinary type supplied to the radio receiver market. However, by shifting a larger portion of the total effort to the manufacturer, the maintenance problem facing the industrial user is greatly reduced. Industrial worth of electronic equipment is measured in terms of its uninterrupted performance in the field. The shift of the maintenance load to the manufacturer reflects back to the field in the form of improved reliability. In general, the manufacturer is better able to cope with the problems attendant to equipment design than is the industrial user able to cope with the now unwieldy problem of maintenance and repair.

The maintenance problem.

The railroads as well as many other industries find it difficult to provide skilled maintenance personnel who can perform necessary technical procedures. The railroad plant, being largely an out-of-doors one extended over miles of open country, does not lend itself to field maintenance of delicate equipment. These factors indicate the need for definite measures to offset the deficiencies in maintenance ability. Obviously, reliability of the highest order would contribute most to this situation. Plug-in assemblies, constructed according to functional units, are a convenient way to insure minimum out-of-service time due to a failure. The concept here is for the user to effect on-the-spot replacement of the faulty subassembly by inserting pretested units in the equipment until the faulty unit is found and replaced. Although this is not a new idea it is an effective way to make repairs and eliminate the need for elaborate field maintenance service.

Until such time as inherent reliability of electron tubes can be materially improved, certain steps can be taken to provide greater reliability consistent with railway operating conditions—provide duplicate equipment for use when the primary system fails, and provide high degree of preventive maintenance.

Action Recommended

Acceptance as information.

CARRIER LEVEL METER

General description.

A carrier level meter has been developed by the Union Switch & Signal Division of the Westinghouse Air Brake Co., to facilitate the installation and maintenance of coded carrier control systems. As these installations usually have other communication facilities superimposed on the same line circuit, the requirements were for a simple portable type instrument which could be used to measure the coded carrier frequencies without disturbing operation of the system and which would be free of interference with signals of other frequencies appearing on the line.

The instrument functions on impulses of carrier so that voltages can be checked quickly and accurately while codes are in progress. This feature is particularly advantageous in that operating margins for both office and field carrier units can readily be determined by measurements made at the office location, without the need for stationing men at remote carrier locations for the purpose of providing a steady signal. Characteristics of the instrument are such that its use produces no adverse effect upon system operation.

Interference from other frequencies appearing on the line is prevented through the use of filters. These filters permit the carrier level meter to be used as a frequency standard for adjusting frequency determining units and transmitting and receiving filters. The use of this meter greatly facilitates such adjustments.

For another important application, the filters can be disconnected and the meter then affords a convenient means for observing unusual phenomena appearing on the line.

The carrier level meter consists essentially of a small oscilloscope and a calibrator combined into a single compact unit assembled in a substantial case. It is designed for operation on 110 volts, 60 cycles, and can be connected to any ordinary outlet of such power. Power consumption is approximately 42 volt-amperes (at 115 volts), which is sufficiently low that the meter can be energized from a tuned alternator or other suitable a.c. source. Switches and dials on the meter are conveniently arranged to facilitate necessary manipulations. The filter is plug connected on top of the instrument case.

Filters used with the carrier level meter are the same highly selective devices regularly employed in the coded carrier control apparatus. Each filter is accurately tuned for a particular frequency. In emergencies, the meter filters can be used as spares for the coded carrier control units.

The basic principle of the carrier level meter is that of visually comparing the amplitude of the coded carrier voltage to that of a known voltage, by means of the oscilloscope. The known or calibrated voltage is supplied by the calibrator whose output is a square wave 60-cycle signal. Since the oscilloscope serves as the indicating device, the unknown voltage may be either coded carrier pulses or a steady signal. Alternate half-cycles of the square wave output of the calibrator are fed to the oscilloscope by means of the back contact of a relay which operates at the rate of 60 complete operations per second. During the other half-cycle intervals, the carrier voltage is applied to the oscilloscope over the front contact of the relay. In this manner a composite

image showing both voltages is presented on the oscilloscope screen. The height of the calibrated voltage can then be adjusted to match the height of the carrier voltage. The voltage reading appears on the dials of the calibrator.

Two optional types of dial markings are available. The more usual type reads directly in volts, while the other type is marked to show decibels.

Applications.

Principal uses of the carrier level meter have been mentioned in the foregoing. The purpose of the following description is to outline briefly the simple procedure for using the meter for several applications.

1. When the carrier level meter is used as a voltmeter, the proper filter is applied and the switches are positioned so that the filter is in the circuit and connected to the line. The relay is started and the gain of the oscilloscope adjusted so that the unknown voltage produces a pattern easily visible on the oscilloscope screen. After the calibrator is turned on, it is adjusted until the amplitude of the calibrated voltage is the same as that of the unknown voltage. The voltage (or decibel) reading appears on the calibrator dials. Where a quick reading must be made, the sweeping rate of the oscilloscope should be set at a low value so that alternate pulses of the carrier voltage and the calibrated voltage appear on the screen. The amplitude of the calibrated voltage is then adjusted to match that of the unknown voltage and the voltage reading obtained from the calibrator dial. In this instance, the 60-cycle pulses of carrier voltage will be interrupted by the centralized traffic control coding. However, experience on a number of installations has proved that this is not confusing. Where greater accuracy is desired and time is not an important factor, the sweeping rate of the oscilloscope should be so adjusted that only a part of the 60-cycle pulse appears on the screen. Under these conditions, the sweeping rate can be so adjusted that the carrier voltage appears as a sine wave curve and the calibrated voltage becomes a straight line superimposed on the sine wave curve. The straight line can then be accurately adjusted to match the tops of the sine wave curve.

2. In using the carrier level meter as a frequency standard for adjusting frequency determining units or transmitting filters the manipulations are essentially the same as when used as a voltmeter. However, when the calibrated voltage is nearly equal to the unknown voltage, the frequency determining unit or the transmitting filter is adjusted to produce maximum possible voltage reading on the meter. During this procedure the oscillator being adjusted is not varied except as may be necessary to bring the image on the oscilloscope screen or to meet other requirements as to voltage levels. For ease in determining when the voltage is a maximum, the calibrating voltage line should be kept near the same height as the unknown voltage. For this kind of adjustment, the meter may be connected to the line anywhere the unknown signal appears. The most natural place, of course, is across the output terminals of the oscillator being adjusted.

3. Practically the same manipulation applies when the meter is used as a frequency standard for checking the adjustment of receiving filters. When the desired frequency determining unit has been adjusted to agree with the standard filter on the meter, the receiving filter to be checked is applied to the meter and the core of the receiving filter adjusted to produce the maximum possible reading on the meter. It should be noted, however, that adjustment of re-

ceiving filters should be made only when there is a definite reason to believe the filter is not functioning properly, and then only by a qualified person. In emergencies, the meter filter may be used in place of the regular receiving filter for any particular frequency

4. When making adjustments prior to placing a coded carrier control installation in service, the carrier level meter is used both as a voltmeter and as a standard of frequency, as necessary. In this application, the calibrated filters used with the meter are considered to be the frequency standards, instead of the receiving filters which are applied to the oscillator-amplifier units. Usual pre-installation adjustments for which the carrier level meter is particularly suited are as follows:

(a) For adjusting frequency determining units as outlined in paragraph 2.

(b) For checking maximum output of oscillator-amplifier units.

(c) For checking sensitivity of all receivers, using the newly adjusted frequency determining units for supplying the required potentials. On any receivers which do not meet specified limits, the tuning of the receiving filters can be checked as mentioned in paragraph 3.

(d) For setting carrier levels, using the carrier level meter as a voltmeter since the readings may be filed for future reference.

(e) For determining the operating margins of the stand-by units. This is done by reducing the transmitting level until failure occurs and measuring the output voltage at this level. The working margin is the ratio of the voltage before reduction and the voltage at which failure occurs.

5. For maintenance tests after an installation is in service, the meter is normally used as a voltmeter but in cases of trouble it may be particularly useful as a frequency standard. Typical maintenance procedures for which the meter is especially convenient are:

(a) For making periodic checks of the operating margins on the normal units for control codes. To do this, the output of each oscillator at the office is measured one at a time, using the carrier level meter during codes so as not to disturb operation of the system. Then the output is reduced to one-third its normal value. If the system still functions, the units are still in satisfactory operating condition.

(b) For making periodic checks of the operating margins of the normal units for indication codes. This is accomplished by measuring, one at a time, the received voltage for each channel. Use of the carrier level meter permits making these measurements during codes, without disturbing operation of the system and without having someone at the remote carrier location to provide a steady signal. After these measurements are made, the voltage supplied to the receiving filter is then reduced to one-third the above value by connecting a variable resistor between the line terminals and the receiving filter. If the system still functions, the original 3 to 1 operating margin still exists.

Action Recommended

Acceptance as information.

LINE FAULT-FINDERS

An application of electronics involving the use of a cathode ray oscilloscope for locating faults and errors throughout the ordinary lengths of open or cabled wire circuits by visual comparison of the variation of the characteristic impedance is described on pages 193 to 198 of the 1948 Proceedings of the Communications Section, A.A.R. Three devices are described, known respectively as the "Lookator," the "Telemetroscope," and the "Fault-Finder," and evidence is presented as to their usefulness in trouble shooting.

Further information covering use of this type of equipment appears on pages 230 to 233 of the 1949 Proceedings and on page 474 of the 1950 Proceedings of the Communications Section, A.A.R.

Action Recommended

Acceptance as information.

COOPERATIVE REPORT

COMMUNICATIONS SECTION, A.A.R.
COMMITTEE 4—RADIO AND ALLIED COMMUNICATIONS

J. I. Kirsch, Representative

Communications Section, A.A.R., Committee 4—Radio and Allied Communications in their meetings during 1951 covered the following items of interest:

1. Investigated the technical feasibility of using ultra high frequency or microwaves. In order to make this type of installation economical, it is necessary to have a need for 10 to 20 telephone channels, together with any control circuits such as centralized traffic control, teletype, etc. At this particular time, it does not appear economically feasible to use microwaves for local operation.

2. Investigated a small portable carrier type battery-operated telephone set for use of railroad maintenance forces. This instrument may find some use in the signal departments of various railroads, conducting I.C.C. tests and placing new signal installations in service.

3. Reported on pulse techniques for measuring vacuum tube characteristics. This may find some application in signal work in testing tubes for carrier and train control equipment.

4. Reported on vacuum tube testing and found that, while systematic tests can do much to prevent tube failures caused by variations of electrical characteristics beyond tolerable limits, the same procedure is not very effective in reducing the inoperable failures, that is, failures due to mechanical defects within the tube itself. It was found that the rate of inoperable failures is highest during the first 100 hours of life and should decrease rapidly thereafter. The Committee is still handling with the tube manufacturers with the view of producing more types of ruggedized tubes.

Action Recommended

Acceptance as information.

COMMITTEE XII—CIRCUIT DESIGN

Personnel

H. A. Scott, Chairman

T. L. Carlson, Vice-Chairman

S. R. Bernard	H. L. Kruke
R. A. Bishop	E. Pitt
B. E. Brooksby	L. B. Sinclair
W. H. Claus	D. H. Steiner
B. R. Dellinger	C. L. Steinmetz
O. C. French	R. E. Testerman
A. N. Goodson	M. R. Williams
H. A. Haines	F. Youngwerth
H. L. Hinton	J. E. McMahon*
E. W. Horning	R. F. Wells*

Signal Section, A.A.R.:

The following outline of work has been assigned:

1. Indexing signal literature.
2. Prepare typical circuits representing current practice for railway signaling, as follows:
 - (a) Automatic block signals.
 1. For track equipped for operation in one direction only.
 - (a) Color light type signals, conventional d.c. track circuits.
 - (b) Searchlight type signals, conventional d.c. track circuits.
 - (c) Coded track circuits with and without use of line wires.
 - (d) Electric switch locking.
 - (e) Spring switch protection.
 - (f) Approach and advance lighting.
 - (g) Light out protection.
 2. For track equipped for operation in both directions.
 - (a) Color light type signals, conventional d.c. track circuits.
 - (b) Searchlight type signals, conventional d.c. track circuits.
 - (c) Coded track circuits.
 - (d) Electric switch locking.
 - (e) Spring switch protection.
 - (f) Approach and advance lighting.
 - (g) Light out protection.
 - (b) Interlocking.
 1. Relay type interlocking, unit and route types.
 - (a) Route-check network (lever-agreement relays).
 - (b) Signal control network.
 1. Color light type signals.
 2. Searchlight type signals.
 - (c) Signal indication.
 - (d) Time locking.

* Consulting Member,

- (b) Interlocking.—Continued.
 - (e) Approach locking.
 - (f) Route locking.
 - (g) Switch locking.
 - (h) Switch control.
 - (i) Switch indication.
 - (j) Power distribution.
 - (k) Model board indications.
 - (l) Remote control circuits.
 - (m) Electric locking of hand-operated switches within interlocking limits.
 - (n) Traffic locking.
 - (o) Movable bridge protection.
- 2. Automatic interlocking.
- (c) Highway crossing signal protection.
 - 1. Control arrangement.
 - (a) Selective speed controls.
 - 2. Types of protection.
 - (a) Flashing lights.
 - (b) Automatic and semi-automatic gates.
- (d) Wayside typical circuits for train stop, train control, and cab signals.
 - 1. Continuous.
 - 2. Intermittent.
- (e) Classification yard signal systems.
 - 1. Hump, repeater, trimmer and switch signal circuits.
 - (a) Color light.
 - (b) Searchlight.
 - 2. Switch control circuits.
 - (a) Electro-pneumatic.
 - (b) Electric.
 - 3. Retarder circuits.
 - (a) Electro-pneumatic.
 - (b) Electric.
 - 4. Special circuits.
- (f) Miscellaneous.
 - 1. Power and color light train order signals.
 - 2. Lightning protection.
 - 3. OSing devices.
 - 4. Control and indication circuits using electronic devices.
- 3. Prepare compilation of principles of basic current design.

The Committee submits for consideration, reports on the following subjects*:

- 2. A.A.R. Sig. Sec. 8059A, 8063A, 8064A, 8065A, 8066A, 8067A, 8068A, 8069A and 8070A.

* Suggestions or criticisms should be submitted in writing to the Chairman of the Committee on or before September 1, 1952.

TYPICAL CIRCUITS REPRESENTING CURRENT PRACTICE
FOR RAILWAY SIGNALING*

The Committee presents 11 typical plans in progressing its assignments. These plans cover traffic control circuits utilizing normally de-energized coded track circuits, circuits for control and indication of a signal function using coded carrier frequency, traffic control circuits between attended and remote controlled interlockings, traffic control circuits using direct current track circuits and two wire line control, circuits for signaling at a spring switch, a typical circuit for coded OSing device, and circuits for automatic interlocking.

These plans represent current practice on one or more Member Roads. The plans are not to be considered as working drawings; rather, it should be understood that these are typical plans only and in their application to a specific signal situation full consideration must be given as to the type of equipment to be employed and the local conditions governing.

The plans presented are:

A.A.R. SIG. SEC.

- 8059A—(Sheets 3 and 4)—Typical normally de-energized coded track circuits and traffic control without line wires. Sheet 3 covers staggered intermediate signal location and Sheet 4 covers coded line circuits for by-passing non-coded track circuits (Fig. 1) and relayed cut-section (Fig. 2). (Assignment 2-a-2-c)
- 8063A—Typical circuits for control and indication of a remote block signal, using coded carrier frequency over existing telephone line. (Assignment 2-f-4)
- 8064A—Typical traffic control circuits between attended and direct wire remote controlled interlockings—mechanical locking at attended location—circuit locking at remote location. (Assignment 2-b-1-n)
- 8065A—Typical traffic control circuits between attended and coded remote controlled interlockings—mechanical locking at attended location—circuit locking at remote location. (Assignment 2-b-1-n)
- 8066A—(Sheets 1 and 2)—Typical traffic control circuits using 2 wire HD line control (end of siding location). (Assignment 2-b-1-1)
- 8067A—Typical circuits for spring switch—track signaled in both directions—with manual clearing of siding signal and approach locking. (Assignment 2-a-2-e)
- 8068A—Typical circuits for spring switch—track signaled in both directions—with siding signal normally clear and approach locking. (Assignment 2-a-2-e)
- 8069A—Typical circuit for coded selective OSing device. (Assignment 2-f-4)
- 8070A—Typical circuits for automatic interlocking using route relays. (Assignment 2-b-2)

Action Recommended

Acceptance as information.

* Previous report on this subject appears in A.A.R. Signal Section 1950 Proceedings, Vol. XLVIII, pp. 348 and 411.

RULES OF ORDER

Effective April 6, 1938

Revised: December 6, 1938; May 22, 1940; March 12, 1941; May 17, 1944;
December 11, 1946; June 8, 1949; May 7, 1952.

1. **REPRESENTATIVES:** The representatives of Member Roads in the Signal Section shall be employees engaged in an official or supervisory capacity in the design, construction or maintenance of railroad signaling devices. Included within this category shall be Signal Superintendents, Signal Engineers and their Assistants, Signal Inspectors, Chief Draftsmen, Signal Supervisors and Assistant Signal Supervisors, or others with corresponding duties.
2. **AFFILIATED MEMBERS:**
 - (a) **RAILROAD AFFILIATED MEMBERS:** A member of a State or Federal regulatory body, or a railroad employee not embraced within the provisions of paragraph 1 (including those temporarily relieved from service or furloughed) may become a **RAILROAD AFFILIATED MEMBER** upon approval of his application by the Committee of Direction. Such a member will pay an annual fee of \$3.00 (which may be changed from year to year at the discretion of the Committee of Direction), on January 1st of each year, for which he will receive currently the Advance Notices and Minutes of the Section.
 - (b) **AFFILIATED MEMBERS:** A representative of an organization or an individual engaged in the design, manufacture, sale or construction of signal devices or materials applicable thereto, or one who is qualified by his business relations and practical experience to cooperate with the Section, may become an **AFFILIATED MEMBER** thereof upon approval of his application by the Committee of Direction. An Affiliated Member will pay an annual fee of \$6.00 (which may be changed from year to year at the discretion of the Committee of Direction), on January 1st of each year, for which he will receive currently the Advance Notices and Minutes of the Section.
 - (c) A Railroad Affiliated or an Affiliated Member shall have the rights and privileges accorded a Member Road representative except voting or the holding of office.
 - (d) A Railroad Affiliated or an Affiliated Member may be appointed as a Consulting Member of any Standing Committee upon the approval of the Committee of Direction.
3. **LIFE MEMBERS:** Life membership may be conferred upon members who retire from active work. They shall have been active in the affairs of the Signal Section and its predecessors and their total term of membership shall have been not less than twenty-five years. Their rights and privileges shall be continued without change. A proposal to confer Life Membership must be signed by five voting representatives of Member Roads and five representatives of Member Roads, stating their reason for

making such proposal. Proposal shall be duly considered at a meeting of the Committee of Direction and then submitted to a vote by letter to the Committee of Direction membership for approval.

Officers and Committees

4. The Officers of the Section shall consist of a Chairman, First Vice-Chairman, Second Vice-Chairman, and Secretary.
 - (a) The Chairman and Vice-Chairmen shall be selected by the Committee of Direction on or before November 1st. Their terms of office shall be one year from January 1st or until their successors are selected and qualified. A Chairman or Vice-Chairman having served a full term shall not succeed himself.
 - (b) The Secretary will be appointed by the Committee of Direction. His salary shall be named by that Committee subject to the approval of the Vice-President, Operations and Maintenance Department of the Association.
 - (c) The COMMITTEE OF DIRECTION will consist of twelve members, as follows: The Chairman, the First Vice-Chairman, the Second Vice-Chairman, the latest Past Chairman, one member from New England or Canada, three members from the East, one member from the South and three members from the West.

The territorial representatives, except when filling vacancies, shall serve four years and their term of office will expire on December 31st of the fourth year.

Vacancies in official positions or of territorial representatives shall be filled until the next election, by the Committee of Direction.

One Vice-Chairman shall be selected from Eastern Territory and one from Western Territory. For this purpose the Eastern Territory will consist of all territory operating under Eastern and Atlantic Standard Time. All other territory will be known as Western Territory. The location of the official's headquarters will determine whether he is in the Eastern or Western territory.

- (d) The Standing Committees of the Section will be as follows:

- I—Economics of Railway Signaling
- II—Interlocking
- III—Signal Shop Practice
- IV—Automatic Block Signaling
- V—Contracts and Instructions
- VI—Designs
- VII—Materials Research
- VIII—Highway Grade Crossing Protection
- IX—Wire and Cable
- X—Signaling Practice
- XI—Electronics
- XII—Circuit Design

The representation of Member Roads on these committees will be, when practicable, territorially selected, in approximately the same proportion as that of the Committee of Direction, the personnel to be named each year by the Committee of Direction.

Duties of Officers

5. The CHAIRMAN shall have general supervision over the affairs of the Section and shall preside at meetings of the Section and at meetings of the Committee of Direction.
6. The FIRST VICE-CHAIRMAN, in the absence of the Chairman, shall perform the duties of the Chairman. He shall perform such other duties as may be assigned to him by the Chairman.
7. The SECOND VICE-CHAIRMAN, in the absence of both the Chairman and First Vice-Chairman, shall perform the duties of the Chairman. He shall perform such other duties as may be assigned to him by the Chairman.
8. (a) The SECRETARY shall devote his entire time to the work of the Section and will perform the usual duties of that office and such other duties as may be assigned to him by the Chairman.
(b) He shall receive on or before November 20th of each year the report of the Committee on Nominations, as elsewhere provided for, and will submit to the voting representatives of Member Roads, not later than November 29th, for letter ballot vote, the nominations contained in that report, to fill the vacancies in the membership of the Committee of Direction. He shall appoint three Tellers from representatives of Member Roads to assist him in counting the ballots, who shall certify the count thereof, with him, to the Committee of Direction. He shall announce the result of the ballot to the Members promptly.
(c) He shall furnish, free of charge, to each representative of a Member Road, designated by such road, one copy of all circulars, Advance Notices and Minutes.
(d) He shall furnish to each Railroad Affiliated, Affiliated and Life Member one copy of all circulars, Advance Notices and Minutes.

Duties of Committees

9. The COMMITTEE OF DIRECTION shall:
 - (a) Exercise general supervision over the interests and affairs of the Section.
 - (b) Be empowered to act on behalf of the Section in the interim between meetings and submit at each meeting a report covering its actions.
 - (c) Examine and decide what portion of communications, papers and reports shall be submitted to the meetings. It shall determine which, if any, of the subjects presented by the various committees shall be referred to the General Committee of the Engineering Division.
 - (d) Appoint on or before October 1st of each year a Committee on Nominations consisting of representatives of five Member Roads, who shall not be members of the Committee of Direction.
 - (e) Appoint additional committees as required.
 - (f) Submit to the Vice-President, Operations and Maintenance Department, detail of contemplated financial requirements for conducting the work of the Section as required or as called for by that official.

- (g) Call Annual meetings of the Section if in its judgment conditions warrant.
 - (h) Call meetings of the Section upon not less than thirty days' notice to each member. It **MUST** call a special meeting of the Section upon the request in writing of a majority of the voting members of Member Roads.
 - (i) Publish Manual of Recommended Practice, in which shall be included such approved Specifications, Drawings, Findings and Conclusions of the Section as the Committee of Direction may find advisable.
10. The **COMMITTEE ON NOMINATIONS**, appointed as prescribed above, shall report to the Secretary on or before November 20th each year at least two nominations for each impending vacancy to replace the territorial representatives on the Committee of Direction.
- The duties of the Standing Committees shall be as follows:
11. **COMMITTEE I—ECONOMICS OF RAILWAY SIGNALING.** Study and report on the economy, if any, of the various signal systems, interlocking, train control, cab signals and other signaling projects.
12. **COMMITTEE II—INTERLOCKING.** Prepare specifications for the various types of interlockings and submit reports on subject-matters relating thereto.
13. **COMMITTEE III—SIGNAL SHOP PRACTICE.** Study and report on signal shop practices.
14. **COMMITTEE IV—AUTOMATIC BLOCK SIGNALING.** Prepare specifications for the various types of automatic block systems and submit reports on subject-matters relating thereto.
15. **COMMITTEE V—CONTRACTS AND INSTRUCTIONS.** Prepare recommended forms for use in connection with signaling contracts and prepare instructions relating to signal maintenance.
16. **COMMITTEE VI—DESIGNS.** Prepare detailed drawings for standardization purposes and make any special study or investigation assigned to it by the Committee of Direction.
17. **COMMITTEE VII—MATERIALS RESEARCH.** Make such investigation of materials used in connection with signaling as directed by the Committee of Direction and submit reports on its conclusions.
18. **COMMITTEE VIII—HIGHWAY GRADE CROSSING PROTECTION.** Prepare requisites for highway grade crossing protection and submit matters of interest relating thereto.
19. **COMMITTEE IX—WIRE AND CABLE.** Prepare specifications for wire and cable, overhead and underground lines and any recommendations relating thereto which will be of interest to the Section.

20. **COMMITTEE X—SIGNALING PRACTICE.** Prepare requisites for the various types of interlocking and block signaling systems, make recommendations having reference to the signal indications which should be given as the varied conditions on railroads require, also submit reports on such other matters as may be assigned by the Committee of Direction.
21. **COMMITTEE XI—ELECTRONICS.** Investigate and report on the use of electronics in connection with railway signal systems, interlocking, centralized traffic control, and highway grade crossing protection.
22. **COMMITTEE XII—CIRCUIT DESIGN.** Prepare typical circuits representative of approved practices and requisites for railroad signaling.
23. **REPRESENTATION OF THE SECTION UPON GENERAL COMMITTEE OF THE ENGINEERING DIVISION:** The five representatives of the Signal Section upon the General Committee of the Engineering Division shall be the Chairman, First Vice-Chairman, Second Vice-Chairman, and two members of the Committee of Direction to be selected by it.
24. **RECOMMENDED PRACTICES:**

Any definition, nomenclature, specification, recommended construction or recommended practice or any proposition having for its objective the formal declaration of the Section upon any matter of importance shall be presented in writing (accompanied by drawings if the latter are necessary for a clear understanding of the subject).

Such submissions will be presented to the Section at its Annual meeting for discussion, and following vote to decide whether or not the proposition shall be submitted to the voting members of Member Roads for adoption or rejection by letter ballot. If the vote to submit is affirmative, the Secretary within three months from the date of the meeting will distribute the ballots with a copy of the Minutes of the meeting, requesting their return within thirty days, naming the date. Ballots mailed after that date, as shown by the postmark, will not be counted. The Secretary shall announce the result of the ballot promptly to the Members. Ballots and envelopes shall be preserved for at least two years from date of announcement. The voting power of the Member Roads shall be as named in paragraph 26.
25. **VOTING AT MEETINGS OF SECTION:** Vote may be taken viva voce, by rising, by roll call or by ballot. Each Member Road shall be entitled to one vote, the ranking officer of a road present at any meeting being recognized as the voting representative of that road, unless otherwise designated by it. The vote of a majority of the Member Roads represented shall be required to decide any question, motion or resolution unless otherwise ordered, except that in the consideration of submitting a question to the letter ballot vote of the Member Roads, all representatives of Member Roads present at any meeting may vote. Thirty representatives of Member Roads shall constitute a quorum.

26. LETTER BALLOTS:

Letter ballots may be taken upon any subject by order of the Committee of Direction and *must* be taken on all questions affecting physical property. The voting power of the Member Roads shall be proportionate to ownership of signal equipment, one vote being counted for each

- 400 signals operating in two positions;
- 250 signals operating in three or four positions;
- 200 interlocked switches, power operated;
- 400 interlocked switches, manually operated;
- 250 highway crossings, automatically protected;
- 1600 train control inductors or loop circuits;
- 800 train control ramp (energized) magnet or coded circuits.

A fraction of a vote in the total of all items, if greater than one-half, shall be counted as one. Each Member Road shall have at least one vote.

Any proposition for which a majority of the votes are affirmative, shall be considered adopted.

27. ORDER OF BUSINESS: The order of business at meetings of the Section shall, unless otherwise directed by a majority of the members present, be as follows:

- Approval of Minutes of Last Meeting;
- Reports of Standing Committees;
- Reports of Special Committees;
- Unfinished Business;
- New Business.

28. Roberts' Rules of Order shall govern the proceedings of the Section, including amendment of these Rules of Order.

RESULT OF LETTER BALLOT ON SUBJECTS APPROVED AT THE
ANNUAL MEETING, SEPTEMBER 10, 11 AND 12, 1951

All subjects submitted to letter ballot were unanimously approved,
as follows:

	For	Against
<i>Committee I—Economics of Railway Signaling</i>		
Conclusions and Findings. (To be removed from Manual Part 103.).....	1101	0
<i>Committee II—Interlocking</i>		
Specification 258-51—Interlocking. (New.).....	1101	0
Specification for Centralized Traffic Control. (Superseding Specification 149-43, Manual Part 97.).....	1101	0
Specification for Electro-Pneumatic Interlocking. (Superseding Specification 67-43, Manual Part 79.).....	1101	0
Specification for Electric Interlocking. (Superseding Specification 65-42, Manual Part 75.).....	1101	0
Specification for Automatic Interlocking. (Superseding Specification 141-43, Manual Part 208.).....	1101	0
Specification for All-Relay Interlocking. (Superseding Specification 203-44, Manual Part 209.).....	1101	0
Specification for Electro-Mechanical and Mechanical Interlocking. (Superseding Specification 66-41, Manual Part 76.).....	1101	0
Requisites for Movable Bridge Interlocking. (Superseding Requisites for Movable Bridge Interlocking, Manual Part 64.).....	1101	0
Specification 76-51—Electric Interlocking Machine. (Superseding Specification 76-49, Manual Part 85.).....	1101	0
Specification 75-51—Mechanical Interlocking Machine, S. & F. Locking. (Superseding Specification 75-46, Manual Part 82.).....	1101	0
Specification 114-46—Mechanical Interlocking Machine, Style "A" Locking. (To be removed from Manual Part 83.).....	1101	0
Requisites for Mechanically Locking the Levers of Interlocking Machines. (Superseding Requisites for Mechanically Locking the Levers of Interlocking Machines, Manual Part 99.).....	1101	0
Specification 198-51—Electric Switch Locks. (Superseding Specification 198-46, Manual Part 109.).....	1101	0
Specification 150-51—Centralized Traffic Control Machine. (Superseding Specification 150-43, Manual Part 98.).....	1101	0
Specification 138-51—Mechanically Operated Circuit Controller for Interlocking Machine Lever. (Superseding Specification 138-44, Manual Part 197.).....	1101	0

For Against

Committee IV—Automatic Block Signaling

Specification 135-51—Track Circuit Bonding. (Superseding section 6-e of Specification 135-50, Manual Part 22.).....	1101	0
Formulae for Computing Minimum Allowable Resistance Between Track Battery and Track and for Computing Related Current and Voltage Data. (Superseding Tables I-IV, inclusive, of Formulae for Computing Minimum Allowable Resistance Between Track Battery and Track and for Computing Related Current and Voltage Data, Manual Part 132.).....	1101	0
Requisites for Track Circuits. (New.).....	1101	0
Requisites for Automatic Block Signaling Circuits. (Superseding Requisites for Automatic Block Signaling Circuits, Manual Part 34.).....	1101	0
Instructions for Minimizing the Effect of Foreign Current on Direct Current Track Circuits. (Superseding Instructions for Minimizing the Effect of Foreign Current on Direct Current Track Circuits, Manual Part 127.).....	1101	0
Requisites for Electric Locks Applied to Hand-Operated Switches for Protection of Main Track Movements. (Superseding Requisites for Electric Locks Applied to Hand-Operated Switches for Protection of Main Track Movements, Manual Part 211.).....	1101	0
Specification 60-51—Installation of Made Ground. (Superseding Specification 60-40, Manual Part 92.).....	1101	0
Specification 52-51—Low-Voltage Lightning Arresters. (Superseding Specification 52-43, Manual Part 95.).....	1101	0

Committee V—Contracts and Instructions

Definitions for Technical Terms Used in Signaling. (To be included in Manual Part 55.).....	1101	0
Specification 257-51—Ground Resistance Testing Instrument. (New.).....	1101	0
Instructions for Automatic Block Signal Systems. (Superseding Instructions for Automatic Block Signal Systems, Manual Part 102.).....	1101	0
Instructions for Interlockings. (Superseding Instructions for Automatic Interlocking, Manual Part 59, and Instructions for Interlocking, Manual Part 138.).....	1101	0
Instructions for Signal Protection for Movable Bridges. (Superseding Instructions for Signal Protection for Movable Bridges, Manual Part 233.).....	1101	0
Instructions for Light and Semaphore Signals. (Superseding Instructions 1 to 57, inclusive, of Instructions for Light and Motor Semaphore Signals, Manual Part 54.).....	1101	0

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	For	Against
<i>Committee V—Contracts and Instructions—Continued</i>		
Instructions for Time Releases Applied to Signal Apparatus. (Superseding Instructions for Time Releases Applied to Signal Apparatus, Manual Part 128.).....	1101	0
Instructions for Switch Circuit Controllers. (Superseding Instructions for Switch Circuit Controllers, Manual Part 134.).....	1101	0
Instructions for Electric Locking. (Superseding Instructions for Electric Locking, Manual Part 199.).....	1101	0

Committee VI—Designs

Specification 231-51—"No Right Turn"—"No Left Turn" Illuminated Sign. (Superseding section 7-a and alternate requisites section R-7-a of Specification 231-50, Manual Part 237.).....	1101	0
Specification 155-51—Railroad Highway Grade Crossing Signs. (Superseding Specification 155-46, Manual Part 44.).....	1101	0
Specification 255-51—Reflex-Reflecting Sheet Material. (New.).....	1101	0
A.A.R. Sig. Sec. 1642F—Railroad Crossing Sign—90 Degree Reflector Type for 4 to 8-Inch Pipe—Assembly. (Superseding A.A.R. Sig. Sec. 1642E in the Manual.).....	1101	0
A.A.R. Sig. Sec. 1645E—Number of Tracks Sign—Reflector Type for 4 to 8-Inch Pipe—Assembly. (Superseding A.A.R. Sig. Sec. 1645D in the Manual.).....	1101	0
A.A.R. Sig. Sec. 1646E—Stop on Red Signal Sign—Reflector Type for 4 to 8-Inch Pipe—Assembly. (Superseding A.A.R. Sig. Sec. 1646D in the Manual.).....	1101	0
A.A.R. Sig. Sec. 1648E—Stop When Swinging Sign—Reflector Type for 4 to 8-Inch Pipe—Assembly. (Superseding A.A.R. Sig. Sec. 1648D in the Manual.).....	1101	0
A.A.R. Sig. Sec. 1692D—Railroad Crossing Sign—50 Degree Reflector Type for 4 to 8-Inch Pipe—Assembly. (Superseding A.A.R. Sig. Sec. 1692C in the Manual.).....	1101	0
A.A.R. Sig. Sec. 1643F—Front Plates for Railroad Crossing Sign—90 Degree Reflector Unit Type—Details. (Superseding A.A.R. Sig. Sec. 1643E in the Manual.).....	1101	0
A.A.R. Sig. Sec. 1693E—Front Plates for Railroad Crossing Sign—50 Degree Reflector Unit Type—Details. (Superseding A.A.R. Sig. Sec. 1693D in the Manual.).....	1101	0
A.A.R. Sig. Sec. 1702B—Front and Back Plates for Stop on Red Signal Sign—Reflector Unit Type—Details. (Superseding A.A.R. Sig. Sec. 1702A in the Manual.).....	1101	0
A.A.R. Sig. Sec. 1703B—Front and Back Plates for Stop When Swinging Sign—Reflector Unit Type—Details. (Superseding A.A.R. Sig. Sec. 1703A in the Manual.).....	1101	0

Committee VI—Designs—Continued

	For	Against
A.A.R. Sig. Sec. 1700B—Front and Back Plates for Number of Tracks Sign—Reflector Unit Type—Details. (Superseding A.A.R. Sig. Sec. 1700A in the Manual.).....	1101	0
A.A.R. Sig. Sec. 1462B—Highway Crossing Signal—Flashing Light Type with Extended Lights and Pedestal Mounted Gate—Assembly. (Superseding A.A.R. Sig. Sec. 1462A in the Manual.).....	1101	0
A.A.R. Sig. Sec. 1489E—Highway Crossing Signal—Flashing Light Type with Suspended Lights and Mast Mounted Gate—Assembly. (Superseding A.A.R. Sig. Sec. 1489D in the Manual.).....	1101	0
A.A.R. Sig. Sec. 1691E—Highway Crossing Sign—50 Degree Reflector Type—Assembly. (Superseding A.A.R. Sig. Sec. 1691D in the Manual.).....	1101	0
A.A.R. Sig. Sec. 1651F—Highway Crossing Signal—Wig-Wag Type with Stop When Swinging Sign—Assembly. (Superseding A.A.R. Sig. Sec. 1651E in the Manual.).....	1101	0
A.A.R. Sig. Sec. 1652F—Highway Crossing Signal—Wig-Wag Type with Stop Sign—Assembly. (Superseding A.A.R. Sig. Sec. 1652E in the Manual.).....	1101	0
A.A.R. Sig. Sec. 1653F—Highway Crossing Signal—Flashing Light Type with Stop on Red Signal Sign—Assembly. (Superseding A.A.R. Sig. Sec. 1653E in the Manual.).....	1101	0
A.A.R. Sig. Sec. 1654F—Highway Crossing Signal—Flashing Light Type with Stop Sign—Assembly. (Superseding A.A.R. Sig. Sec. 1654E in the Manual.).....	1101	0
A.A.R. Sig. Sec. 1686F—Highway Crossing Signal—Flashing Light Type, 6 Ft. and 8 Ft. Cantilever Span—Assembly. (Superseding A.A.R. Sig. Sec. 1686E in the Manual.).....	1101	0
A.A.R. Sig. Sec. 1688D—Highway Crossing Signal—Flashing Light Type, 10 Ft. and 12 Ft. Cantilever Span—Assembly. (Superseding A.A.R. Sig. Sec. 1688C in the Manual.).....	1101	0
A.A.R. Sig. Sec. 1705A—Front Plates for 50 Degree Railroad Crossing Sign—Reflex-Reflecting Sheet Type for Back Plates 17041 and 17042—Details. (New.).....	1101	0
A.A.R. Sig. Sec. 1706A—Front Plates for 90 Degree Railroad Crossing Sign—Reflex-Reflecting Sheet Type for Back Plates 17011 and 17012—Details. (New.).....	1101	0
A.A.R. Sig. Sec. 1707A—Front Plates for Number of Tracks Sign—Reflex-Reflecting Sheet Type for Back Plate 17001—Details. (New.).....	1101	0
A.A.R. Sig. Sec. 1708A—Front Plate for Stop on Red Signal Sign—Reflex-Reflecting Sheet Type for Back Plate 17021—Detail. (New.).....	1101	0
A.A.R. Sig. Sec. 1709A—Front Plate for Stop When Swinging Sign—Reflex-Reflecting Sheet Type for Back Plate 17031—Details. (New.).....	1101	0

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Committee VI—Designs—Continued

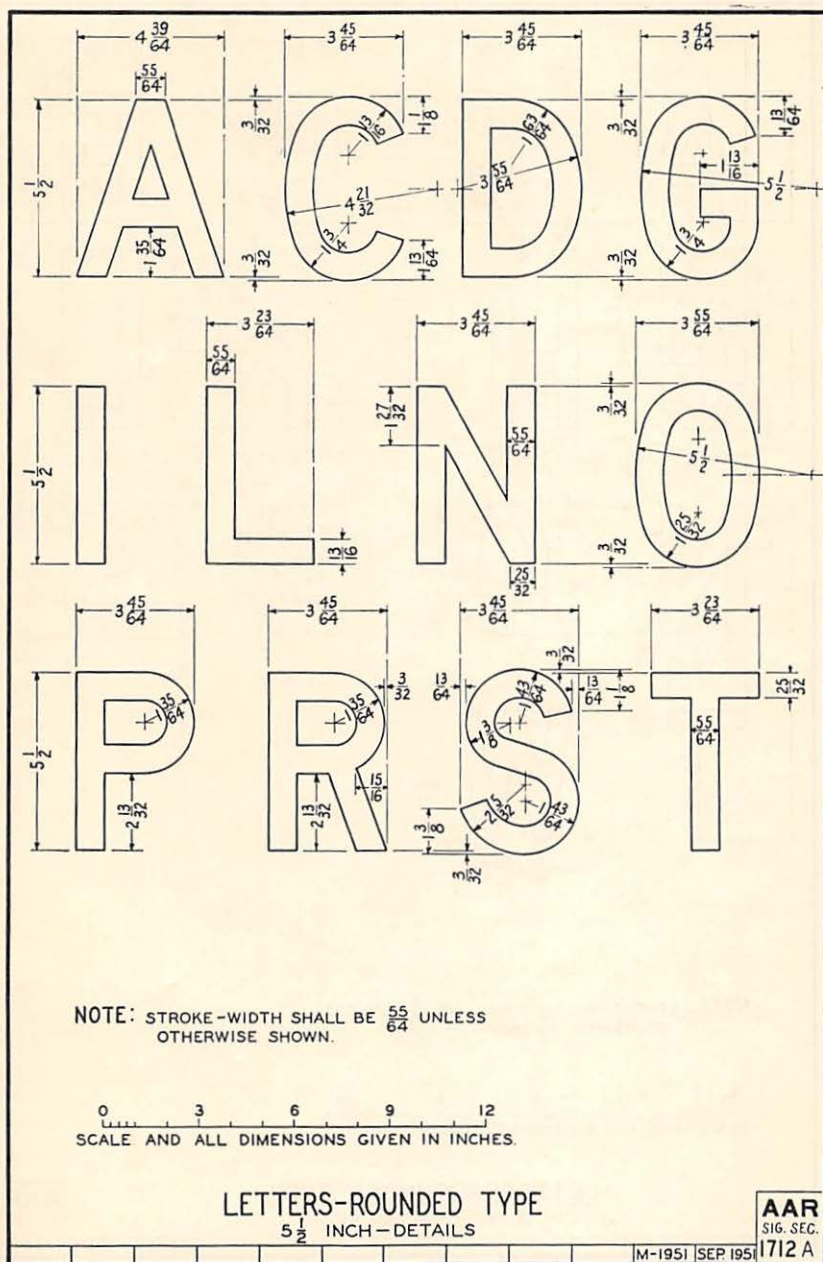
	For	Against
A.A.R. Sig. Sec. 1715A—50 Degree Railroad Crossing Sign—Reflex-Reflecting Sheet Type for 4 to 8-Inch Pipe—Assembly. (New.).....	1101	0
A.A.R. Sig. Sec. 1716A—Plates for 50 Degree Railroad Crossing Sign—Reflex-Reflecting Sheet Type—Details. (New.).....	1101	0
A.A.R. Sig. Sec. 1717A—90 Degree Railroad Crossing Sign—Reflex-Reflecting Sheet Type for 4 to 8-Inch Pipe—Assembly. (New.).....	1101	0
A.A.R. Sig. Sec. 1718A—Plates for 90 Degree Railroad Crossing Sign—Reflex-Reflecting Sheet Type—Details. (New.).....	1101	0
A.A.R. Sig. Sec. 1719A—Number of Tracks Sign—Reflex-Reflecting Sheet Type for 4 to 8-Inch Pipe—Details and Assembly. (New.).....	1101	0
A.A.R. Sig. Sec. 1720A—Stop on Red Signal Sign—Reflex-Reflecting Sheet Type for 4 to 8-Inch Pipe—Details and Assembly. (New.).....	1101	0
A.A.R. Sig. Sec. 1721A—Stop When Swinging Sign—Reflex-Reflecting Sheet Type for 4 to 8-Inch Pipe—Details and Assembly. (New.).....	1101	0
A.A.R. Sig. Sec. 1712A—Letters—Rounded Type—5½ Inch—Details.* (New.).....	1101	0
A.A.R. Sig. Sec. 1713A—Letters—Rounded Type—4 Inch—Details.* (New.).....	1101	0
A.A.R. Sig. Sec. 1714A—Numerals—Rounded Type—5½ Inch—Details.* (New.).....	1101	0

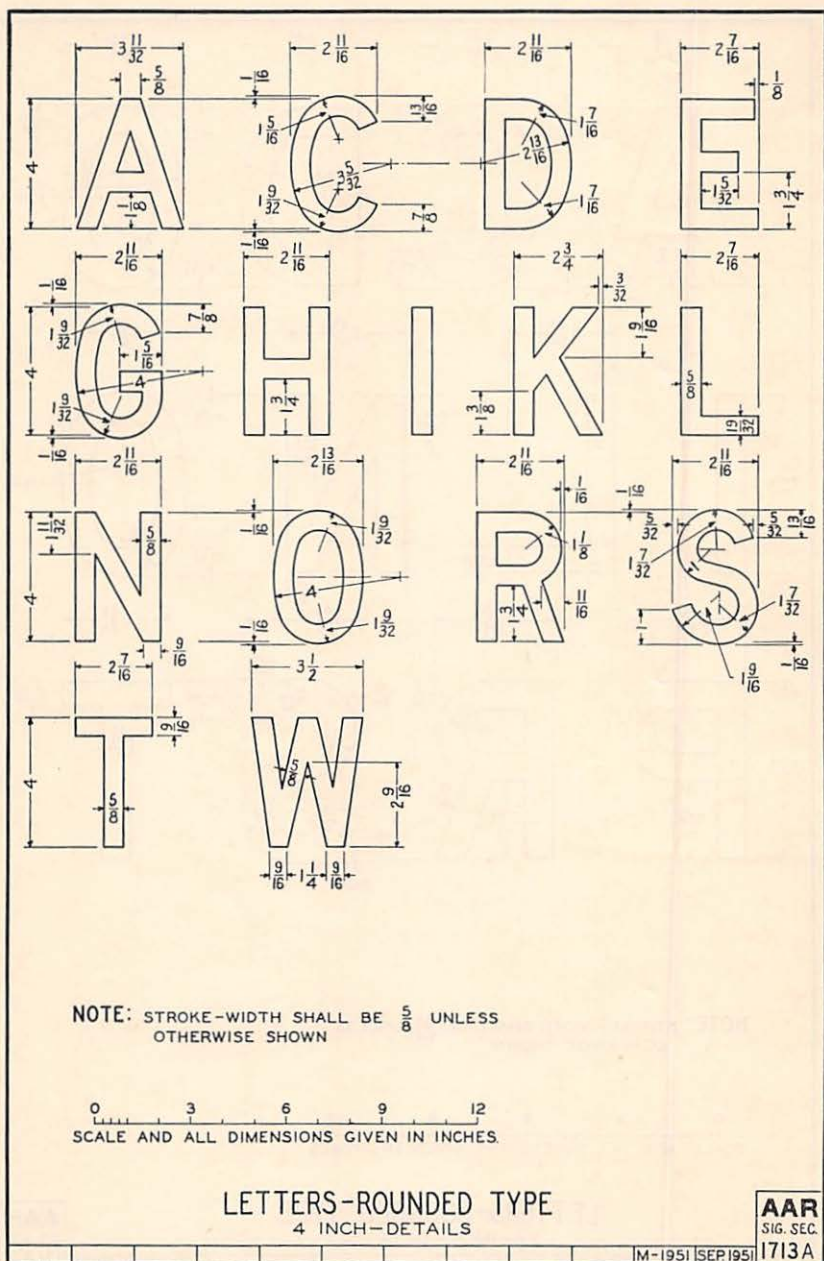
Committee VII—Materials Research

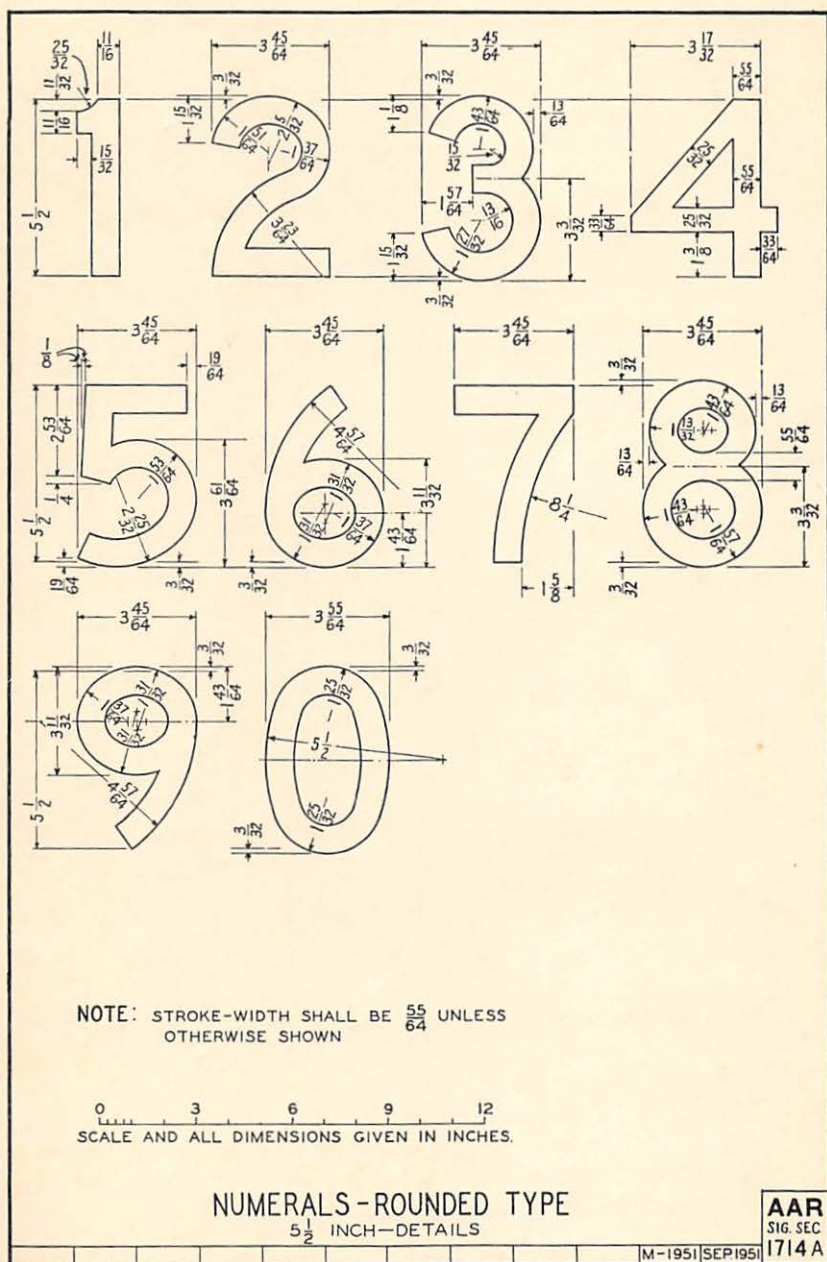
Specification 144-51—Dry Process Porcelain Insulation. (Superseding Specification 144-39, Manual Part 80.).....	1101	0
Specification 120-51—Painting. (Superseding Specification 120-50, Manual Part 110.).....	1101	0
Specifications for Various Types of Steel. (Superseding Specifications for Various Types of Steel, Manual Part 154.).....	1101	0

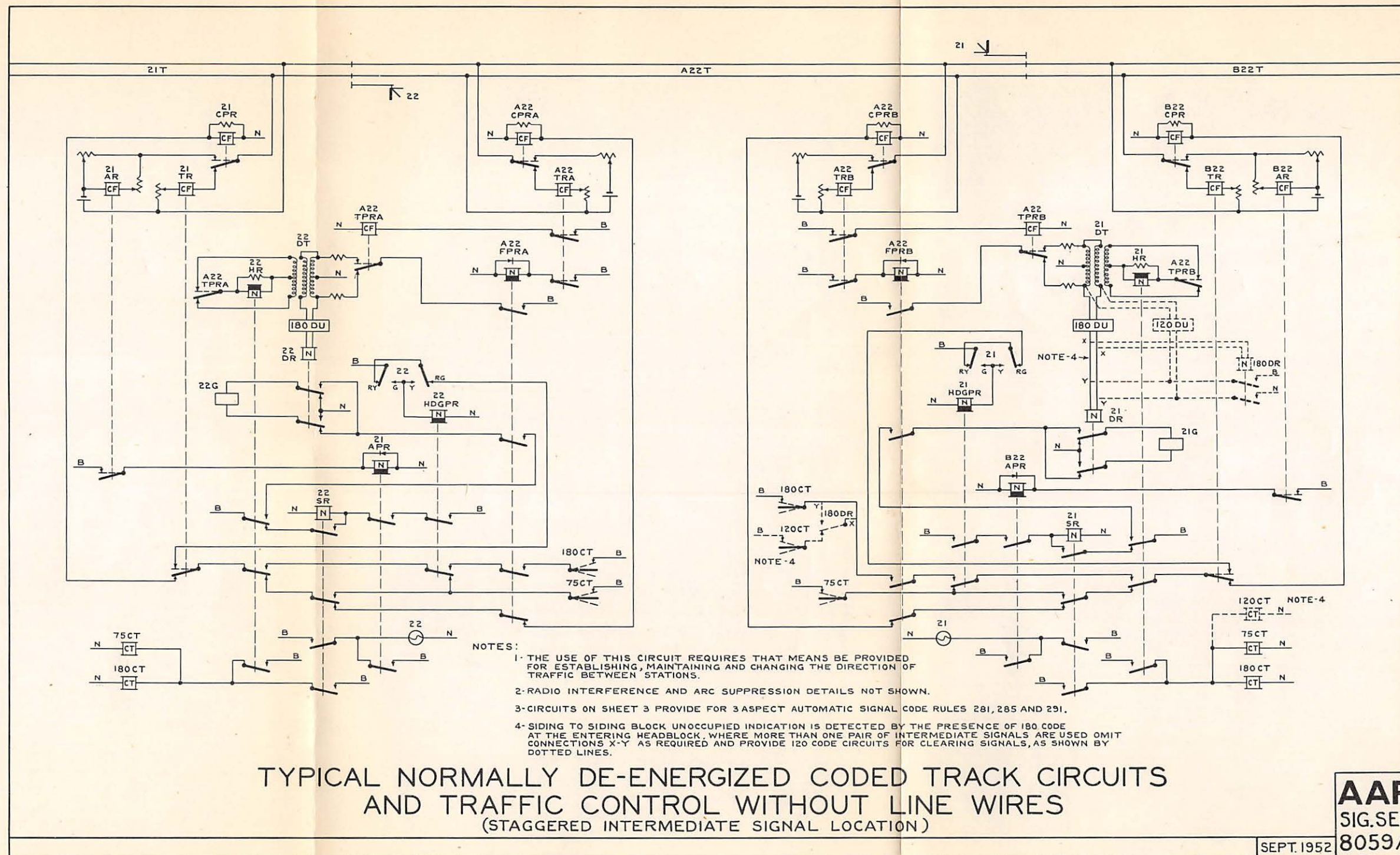
* As a result of revision of drawings on the floor of the 1951 Annual Meeting, to show rounded type letters and numerals, Committee VI—Designs found it necessary to prepare three additional drawings covering details of such letters and numerals. On completion, these drawings: namely, A.A.R. Sig. Sec. 1712A, 1713A and 1714A, were approved by the Signal Section Committee of Direction for inclusion in the 1951 Letter Ballot as part of Committee VI's submission. See pages 345, 346 and 347.

	For	Against
<i>Committee X—Signaling Practice</i>		
Requisites for Protection for Spring Switches. (Superseding Requisites for Spring Switches, Manual Part 10.).....	1101	0
Requisites for Automatic Block Signaling Systems. (Superseding Requisites for Automatic Block Signaling Systems, Manual Part 87.).....	1101	0
Requisites for Take or Leave Siding Indicator. (Superseding Requisites for Take Siding Indicator and Leave Siding Indicator for Non-Interlocked Switch, Manual Part 71.)....	1101	0
Requisites for Interlocking. (Superseding Requisites for Interlocking, Manual Part 94.).....	1101	0









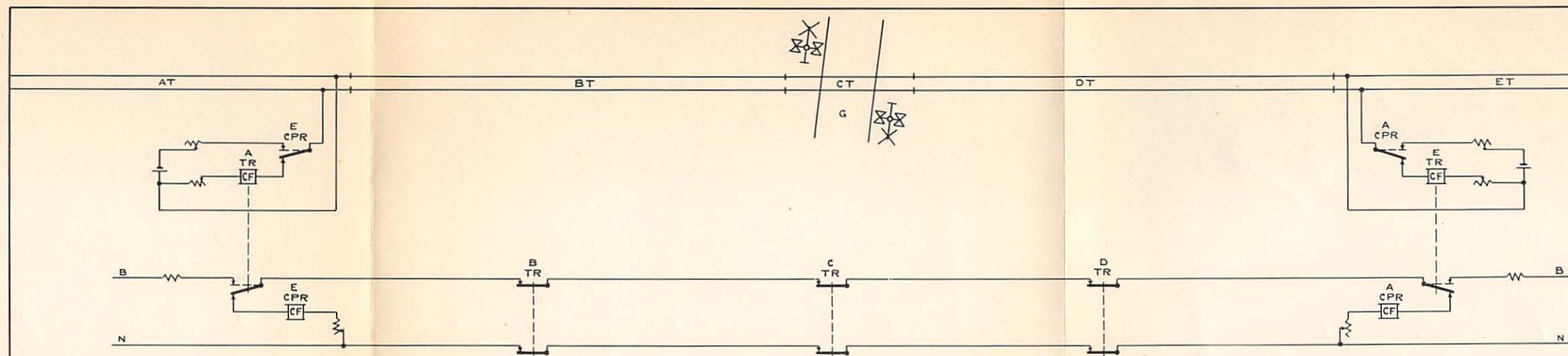


FIG. 1
CODED LINE CIRCUITS FOR BY-PASSING NON-CODED TRACK CIRCUITS

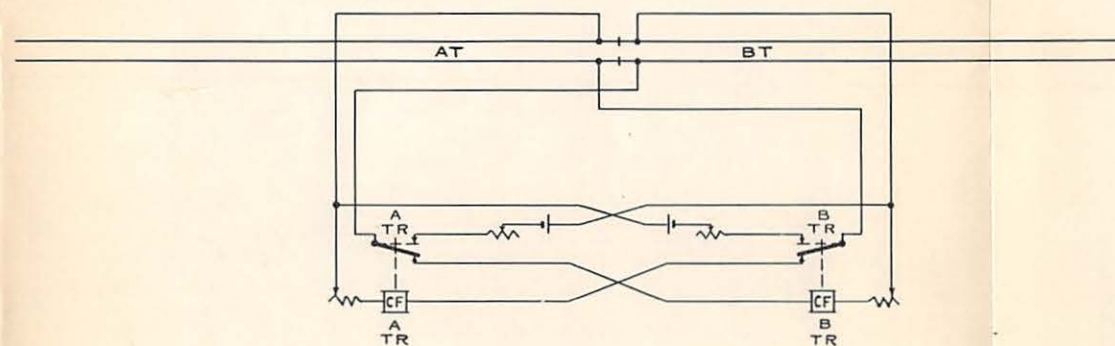
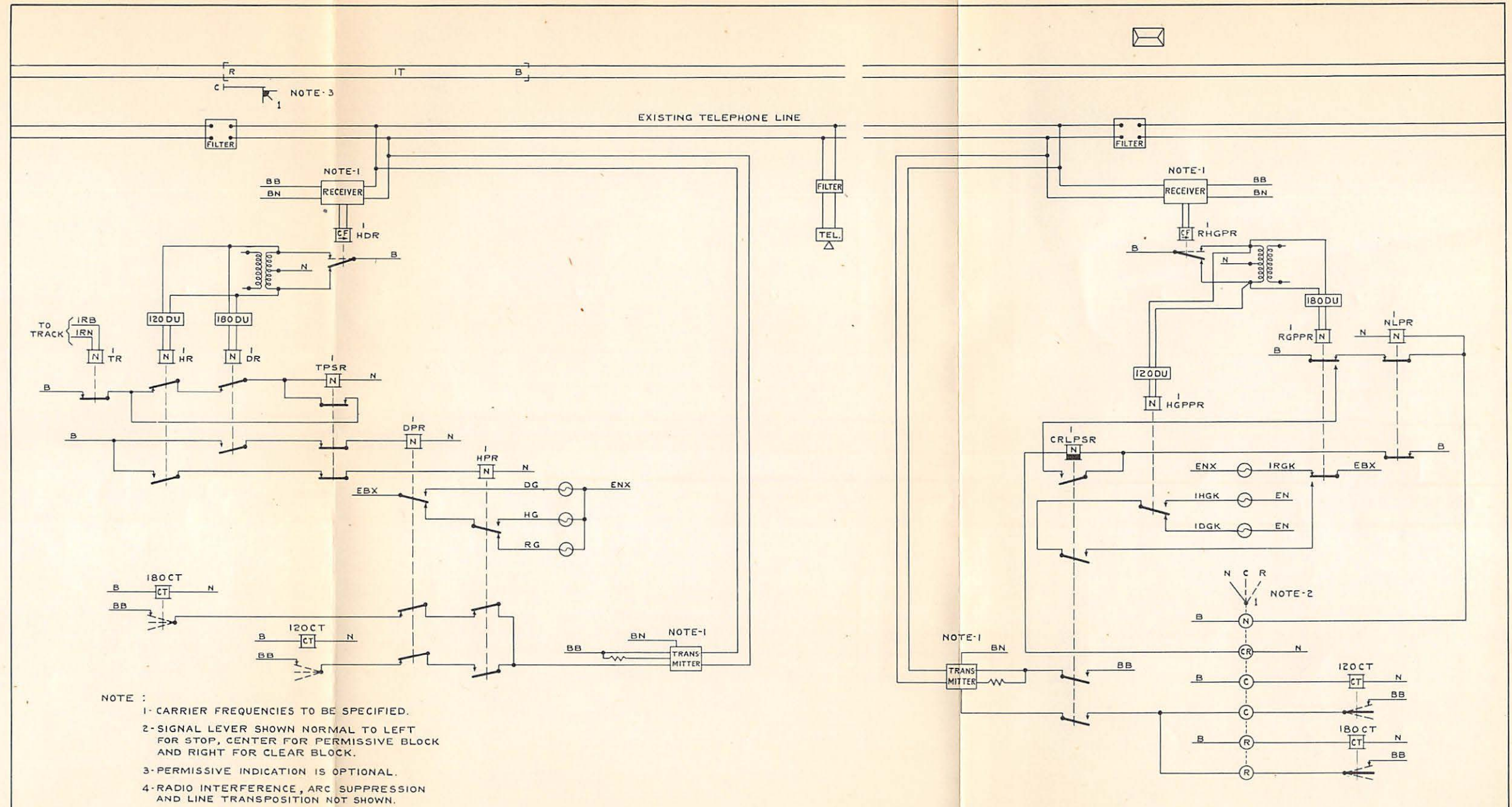


FIG. 2
RELAYED CUT-SECTION

NOTE:
RADIO AND ARC SUPPRESSION
DETAILS NOT SHOWN.

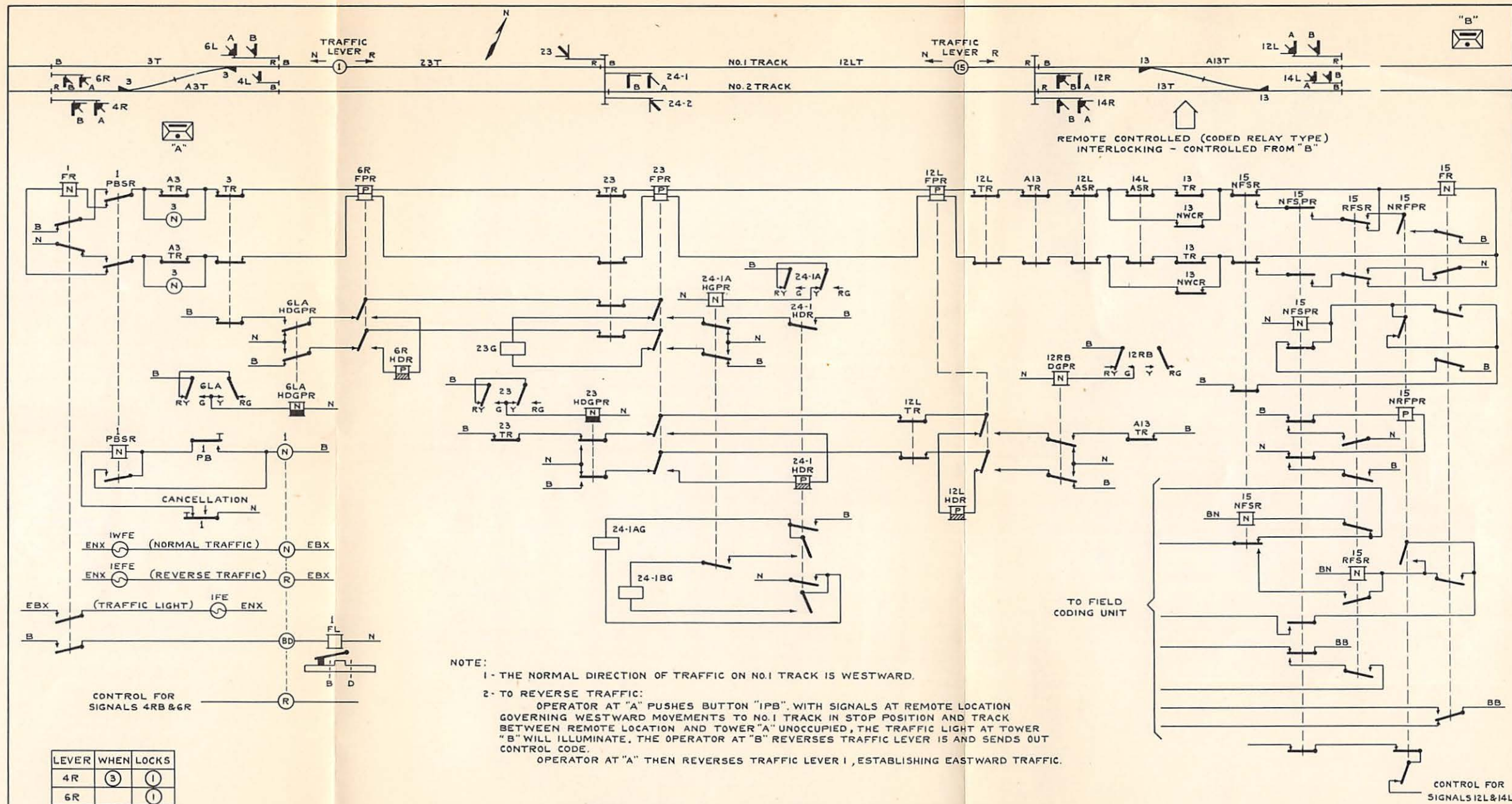
TYPICAL NORMALLY DE-ENERGIZED CODED TRACK CIRCUITS
AND TRAFFIC CONTROL WITHOUT LINE WIRES



TYPICAL CIRCUITS FOR CONTROL AND INDICATION OF A REMOTE BLOCK SIGNAL, USING CODED CARRIER FREQUENCY OVER EXISTING TELEPHONE LINE

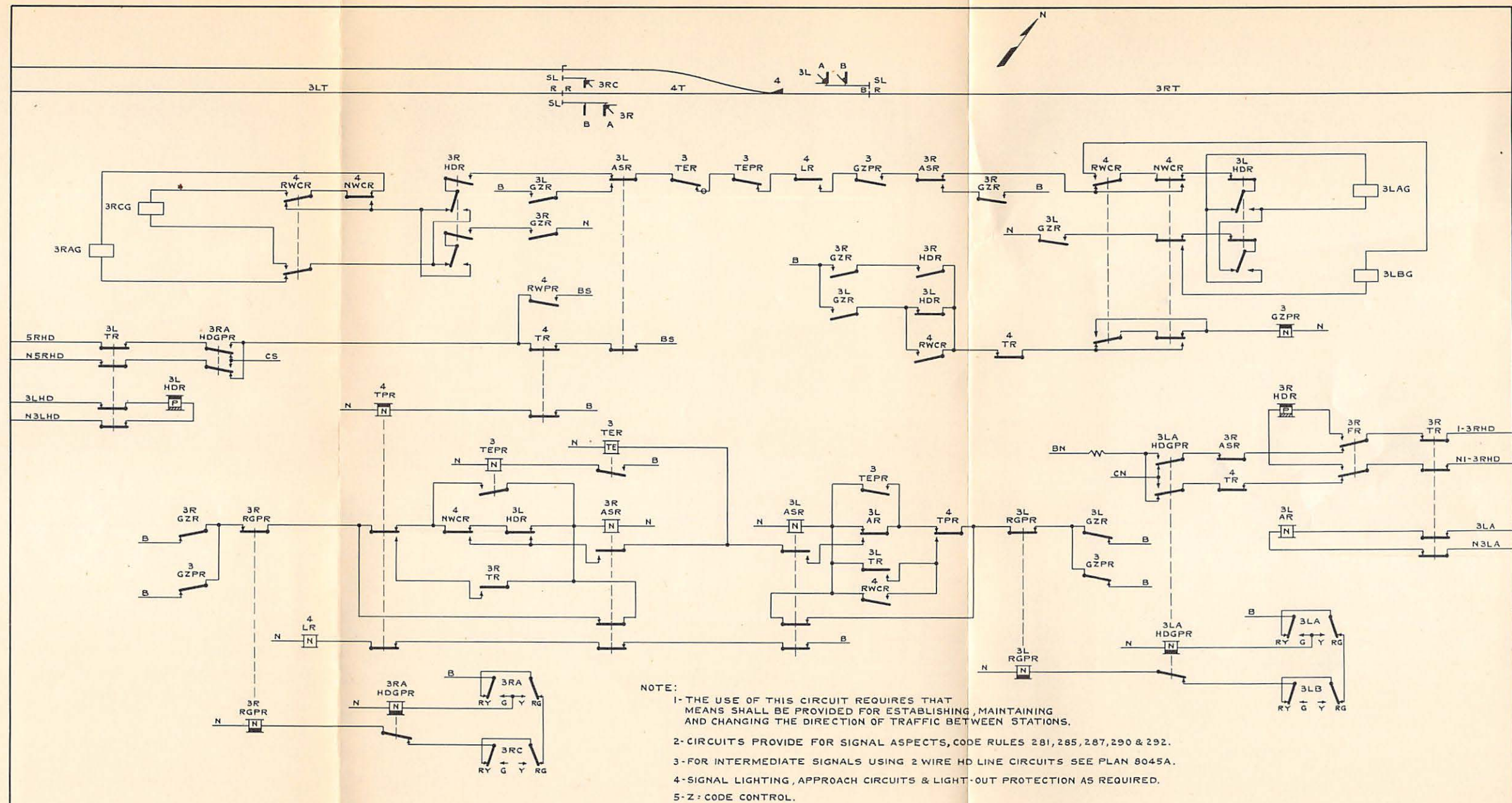
SEPT. 1952

AAR
SIG. SEC.
8063A



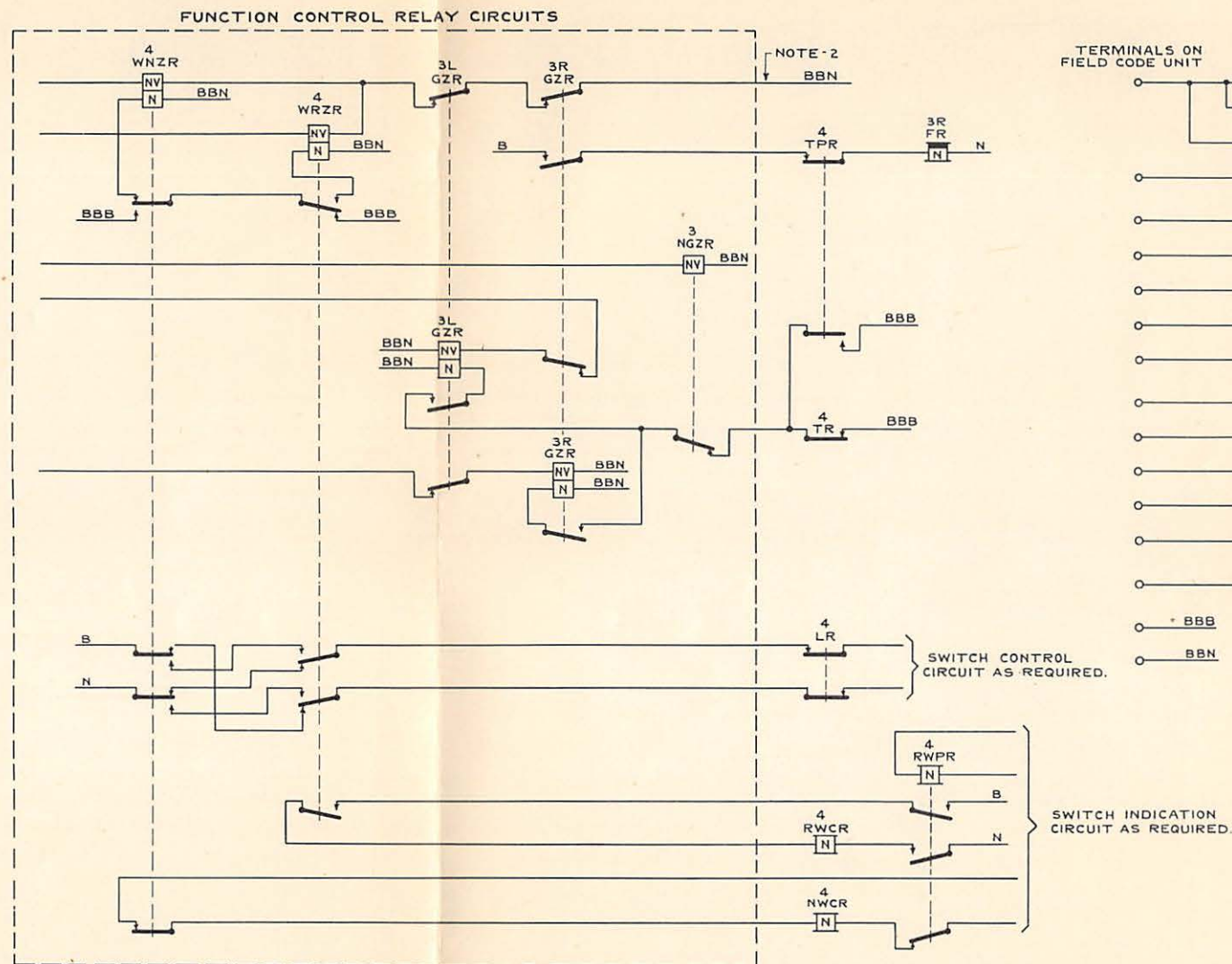
TYPICAL TRAFFIC CONTROL CIRCUITS BETWEEN ATTENDED AND CODED REMOTE CONTROLLED INTERLOCKINGS

MECHANICAL LOCKING AT ATTENDED LOCATION
CIRCUIT LOCKING AT REMOTE LOCATION



TYPICAL TRAFFIC CONTROL CIRCUITS

USING 2 WIRE HD LINE CONTROL (END OF SIDING LOCATION)



NOTE :

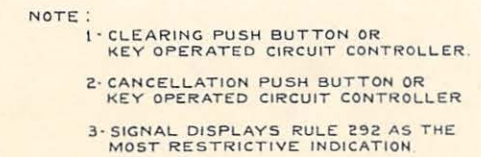
- 1- THESE CIRCUITS WILL VARY WITH THE TYPE OF CODE SYSTEM EMPLOYED
- 2- TO PREVENT STORAGE OF SWITCH CONTROL CODE, SELECT OVER FRONT CONTACT OF LR.
- 3- Z = CODE CONTROL

TYPICAL TRAFFIC CONTROL CIRCUITS

USING 2 WIRE HD LINE CONTROL (END OF SIDING LOCATION)

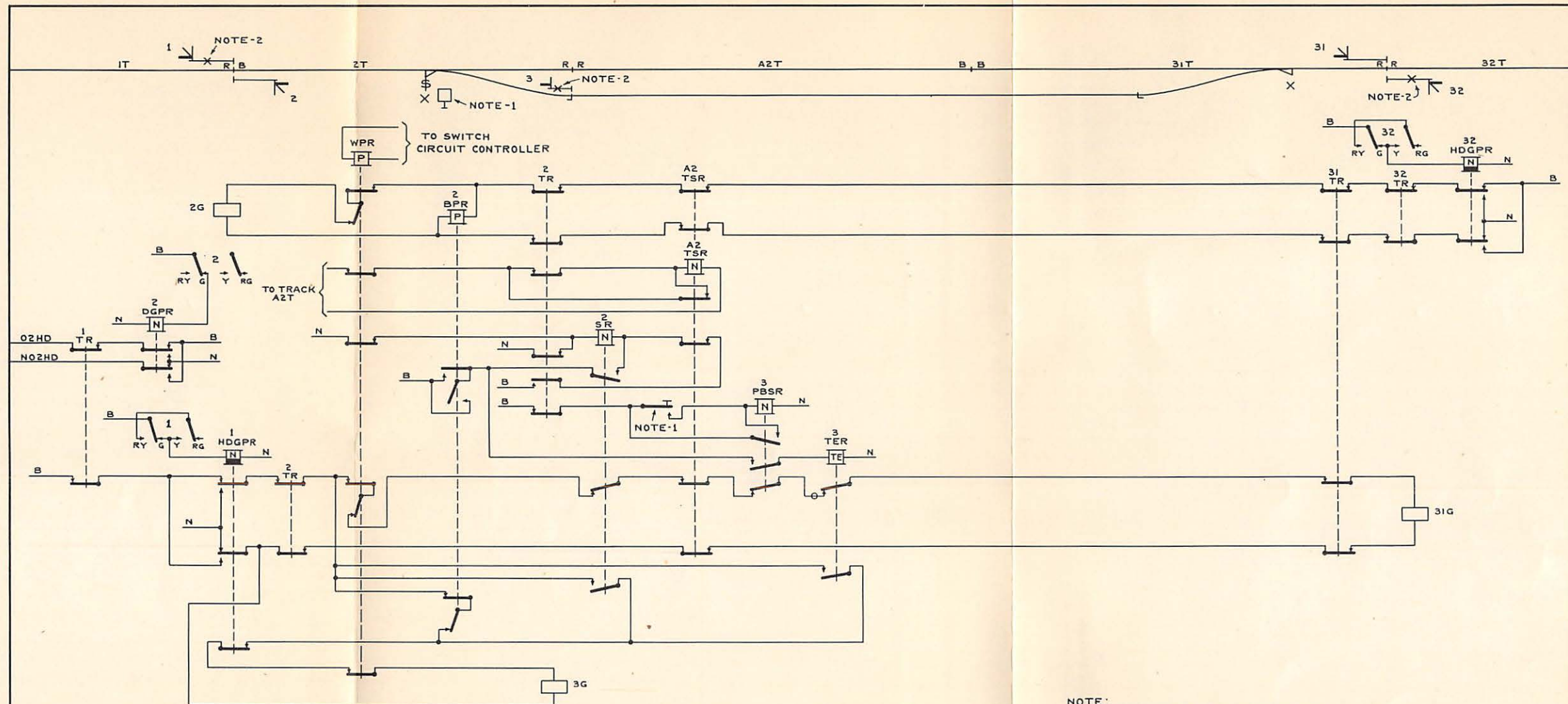
SEPT. 1952

AAR
SIG. SEC.
8066A



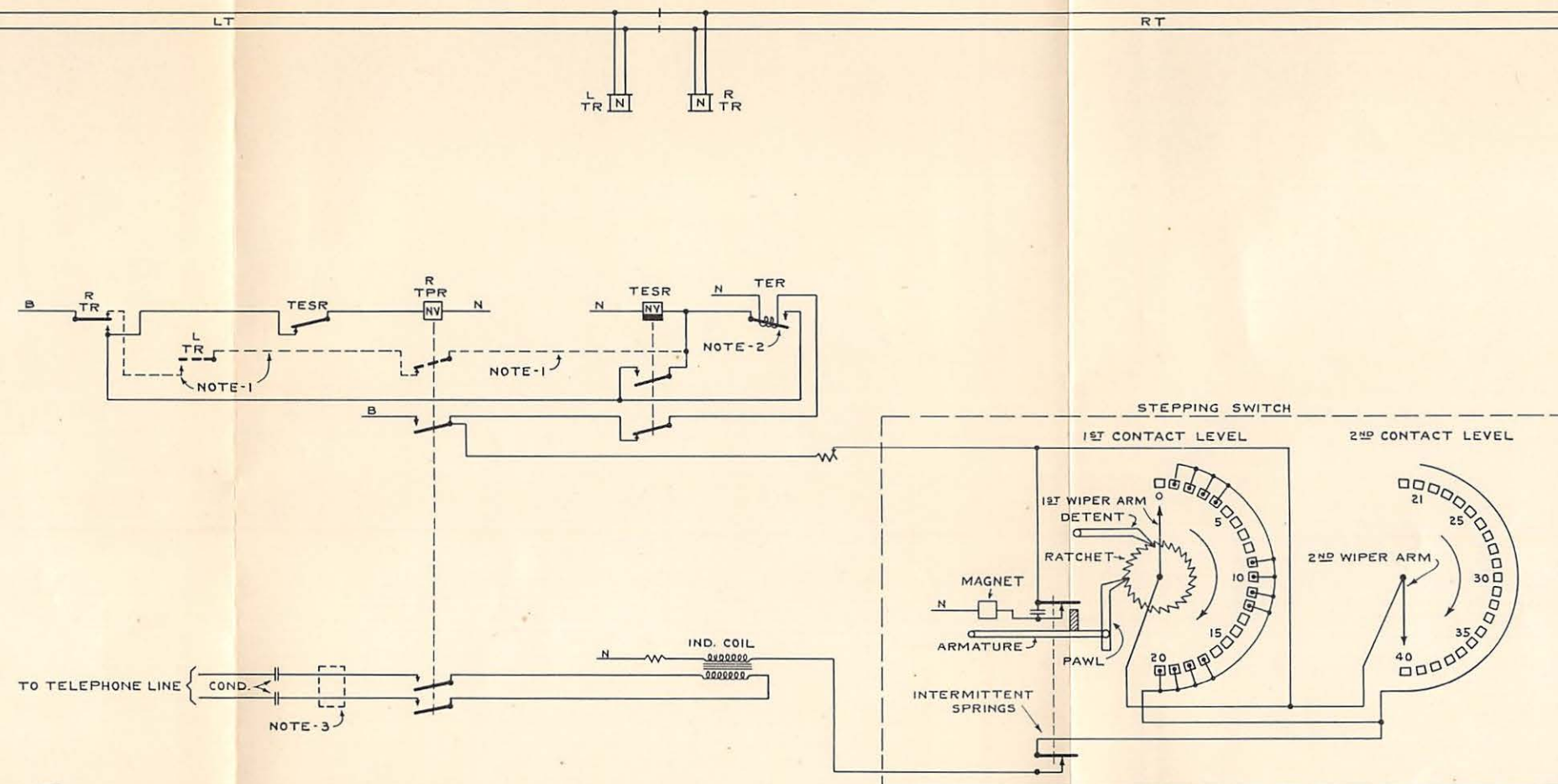
TYPICAL CIRCUITS FOR SPRING SWITCH

TRACK SIGNALLED IN BOTH DIRECTIONS
WITH MANUAL CLEARING OF SIDING SIGNAL AND APPROACH LOCKING.



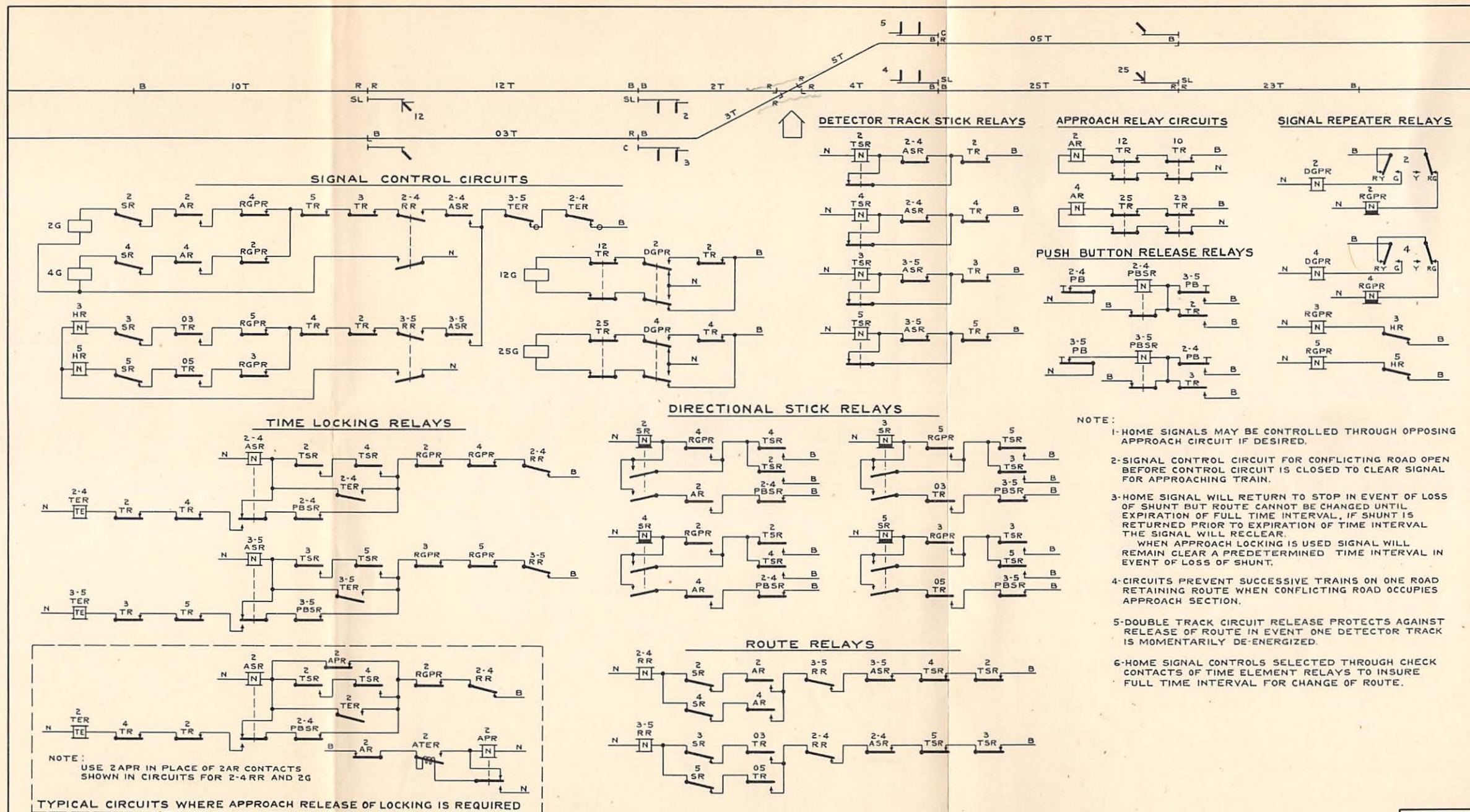
NOTE:
1- EMERGENCY PUSH BUTTON OR
KEY OPERATED CIRCUIT CONTROLLER.
2- SIGNAL DISPLAYS RULE 292 AS THE
MOST RESTRICTIVE INDICATION.

TYPICAL CIRCUITS FOR SPRING SWITCH
TRACK SIGNALLED IN BOTH DIRECTIONS
WITH SIDING SIGNAL NORMALLY CLEAR AND APPROACH LOCKING.



- NOTE:
- 1-DIRECTIONAL FEATURE CAN BE PROVIDED BY ADDITION OF CIRCUITS INDICATED BY DOTTED LINES.
 - 2-SETTING OF TIME ELEMENT RELAY TO BE ADJUSTED AS CONDITION REQUIRES.
 - 3-FILTER TO BE INSTALLED IF CARRIER CIRCUIT IS PRESENT ON DISPATCHERS LINE.

TYPICAL CIRCUIT FOR CODED SELECTIVE RINGING DEVICE.



TYPICAL CIRCUITS FOR AUTOMATIC INTERLOCKING

USING ROUTE RELAYS

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SIGNAL SECTION, A.A.R.

ADVANCE NOTICE

September 29, 30 and October 1, 1952

The shop is located adjacent to the storeroom and the Stores Department handles all the incoming and outgoing material. All work performed in the shop is done under shop orders issued by the Storekeeper.

At the time of the inspection the shop forces consisted of 16 employees, as follows:

- 1 Foreman
- 2 Leading Signal Mechanics
- 9 Signalmen
- 2 Assistant Signalmen
- 2 Signal Helpers

This force reports directly to the Signal Engineer's office.

The nature of the equipment, as well as its arrangement, is indicated on shop layout plan, Fig. 1. It will be noted that the general repairs are made in the main shop, while relays, C.T.C. apparatus and like equipment are handled in the enclosed area shown on Fig. 1 as "Relay & C.T.C. Repair Room."

The general repairs consist principally of all the items used by the Signal Department of the Erie R. R., including signal mechanisms, switch machines, both electric and pneumatic, signal masts, etc., and a space is provided for the regrounding of track bond drills.

From the records on direct current relays repaired in this shop, it was disclosed that the average monthly production was 110 relays, which utilized 468 man hours, giving an average of 4.25 man hours per relay.

All facilities in the shop are used for signal repairs, there being no attempt to manufacture any signal apparatus.

Photographs of the interior of the shop are shown in Figs. 2, 3, 4 and 5.

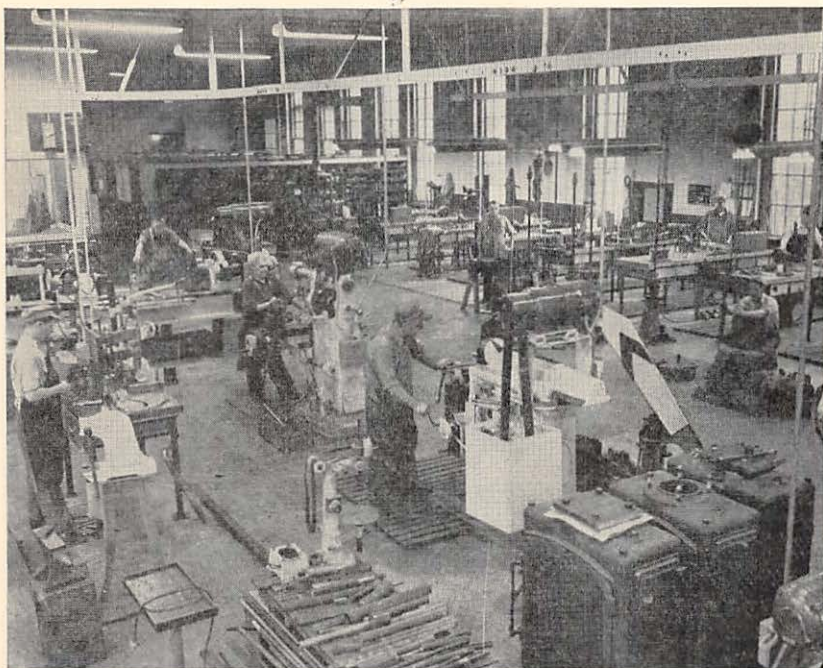


Fig. 2.



Fig. 3.

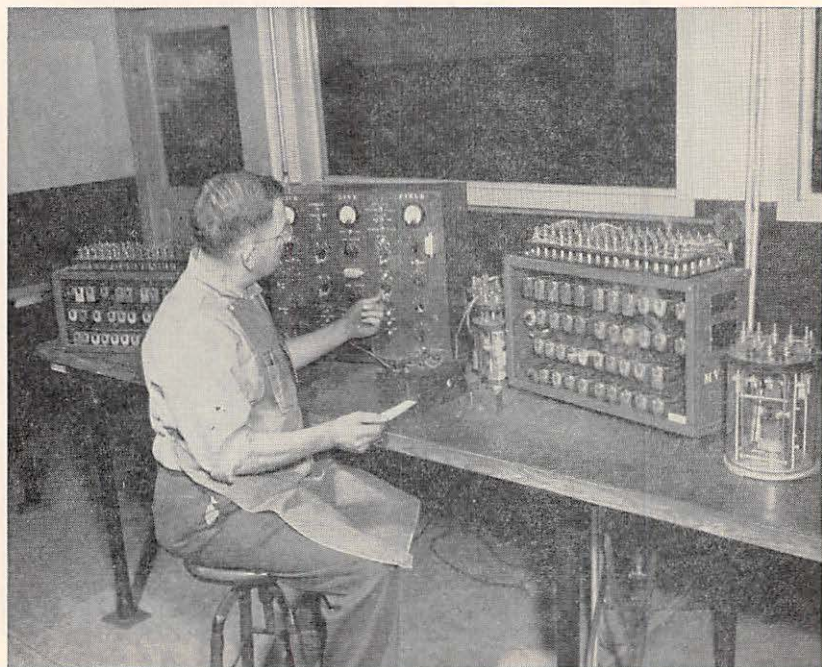


Fig. 4.

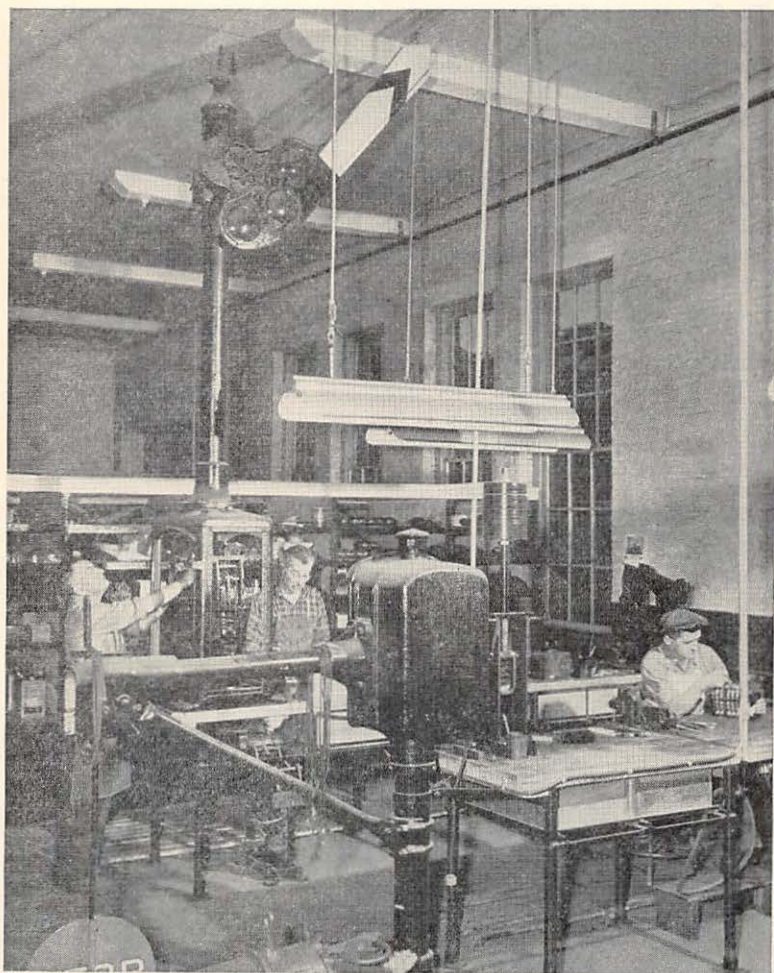


Fig. 5.

Norfolk & Western Ry. Reclamation Shop.

This layout centers around a three-story building which has approximately 14,000 square feet of floor space. There is a considerable area around this building, which is used for the storage of material to be repaired or reclaimed, and the area is also used to wire large cases and other instrument housings. The force consisted of 38 employees.

The operation of this shop is a definite departure from the usual type of shop handling signal repairs, in that they repair, reclaim and fabricate many items in addition to signal apparatus. It was noted that part of the track motor car repairs for the system as well as the repair of gasoline-driven Maintenance-of-Way Department tools were included.

The original shop was set up in 1920, with one man and one bench. Since that time it has expanded to its present size, utilizing space when and as available. The present shop operation is now carried on with each type of repair confined to a room or space allotted to the various operations. Table I lists repair facilities and equipment.

The Signal Storekeeper is located in the shop building and although he reports to the General Storekeeper, his instructions and guidance as to stock requirements are issued by the Superintendent of Telegraph and Signals.

The Storekeeper stores the new material as received and also handles material returned by the field forces to be repaired. When material is returned by field forces, it is screened by a supervisor who considers the possible future use of the various items. If the item is suitable for repair and the estimated

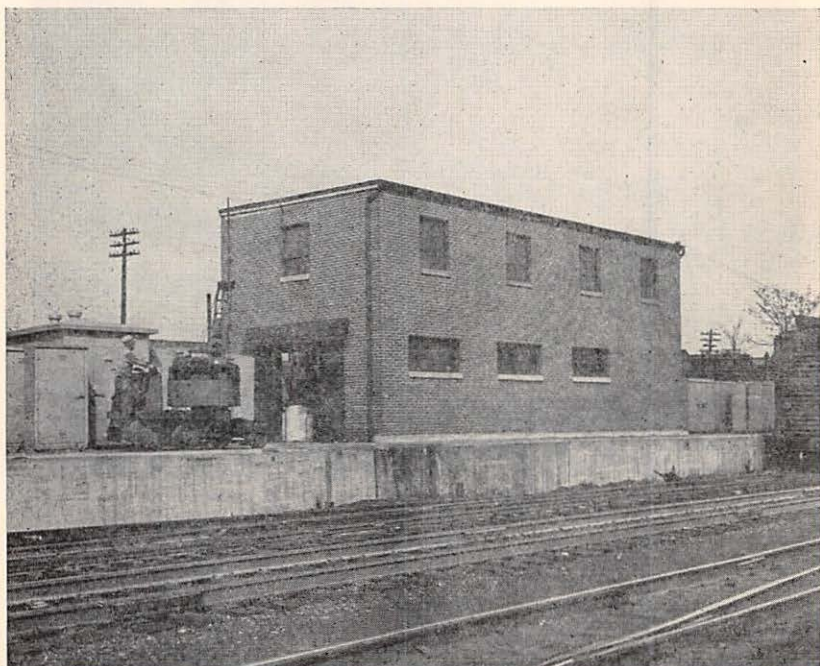


Fig. 6.



Fig. 7.



Fig. 8.

cost is not excessive, it is scheduled for repairs by the Shop Foreman. The item is then covered by a shop order, is processed through the various stages, and when repairs have been completed is returned to be carried in stock.

A separate two-story fireproof building is located within the shop area, in which all case and instrument house wiring is handled for construction work on the entire system. A signal construction force consisting of a Foreman and from six to ten men of the various signal construction force classifications, depending on the current authorities, handles this phase of the work. In order to familiarize all Construction Department employees with case wiring, construction forces are rotated periodically. Figs. 6, 7 and 8 show the case wiring department.

In general, the Norfolk & Western operation is noteworthy as they, in spite of the complications imposed by the widely diversified activities, adhere to the principles previously set forth by Committee III in connection with costs, arrangement and procedure*.

TABLE I

Repair Facilities and Equipment

Machine Shop.

- 1—24" x 7' lathe
- 1—12" x 54" lathe
- 1—12" x 30" lathe
- 1—Sellers bonding drill grinder
- 1—Do-All Metal Master 16" capacity saw and filing machine
- 1— $\frac{1}{2}$ " floor model drill press
- 1—Pipe threading machine
- 1—7" bench grinder
- 1—20" drill press
- 1—Hydraulic press 50-ton

Carpenter Shop.

- 1—24" band saw
- 1—10" combination rip and cut-off saw and 6" jointer
- 1—8" jointer
- 1— $\frac{1}{2}$ " floor model drill press
- 1—Portable belt sander
- 1— $\frac{1}{4}$ " portable electric drill
- 1— $\frac{1}{2}$ " portable electric drill
- 1—Portable electric screwdriver
- 1—Skilsaw

* A.A.R. Signal Section 1950 Proceedings, Vol. XLVIII, p. 155, and A.A.R. Signal Section 1949 Proceedings, Vol. XLVII, pp. 93-96, inclusive.

TABLE I—Continued

Instrument and Photographic Laboratory.

- 1—6" lathe
- 1—7" shaper
- 1— $\frac{1}{2}$ " drill press
- 1—6 $\frac{1}{2}$ " bench milling machine
- 1—6" bench grinder
- 1—4" x 5" camera
- 1—4" x 5" enlarger
- 1—36" plate whirler
- 1—15" x 17" vacuum printing frame
- 1—6" x 30" printer
- 1—12" x 12" hot plate
- 1—4" x 5" camera rack
- 1—31" x 24" etching machine
- 1—Paint sprayer
- 1—Photographic print drier
- 1—Microscope with laboratory stand
- 1—20" print trimmer
- 4—Wratten safe lights
- 1—Sink with 4' drain board
- 6—Storage cabinets
- 1—Magnetic chuck
- 1—Dividing head
- 1—Stenciling machine

Blacksmith Shop.

- 2—Forges
- 2—Anvils
- 1—Bench grinder
- 1—Shop-made drill press
- 1—Carriage vise
- 1—Layout table
- 2—Portable acetylene torches
- 1— $1\frac{1}{2}$ -ton portable electric crane
- 1—Bench vise
- 1—Pneumatic forming press

Sheet Metal Shop.

- 1—10" bench grinder
- 1— $\frac{1}{2}$ " drill press
- 1—42" metal shear
- 1—6" metal shear
- 1—30" bending brake, 18-gage capacity
- 1—8' bending brake, 14-gage capacity
- 1—Power-driven forming roll
- 1—36" roll, 16-gage capacity
- 1—300-ampere electric welding machine

TABLE I—Continued

Sheet Metal Shop.—Continued.

- 1—Welding torch, acetylene
- 1— $\frac{1}{4}$ " portable electric drill
- 1—Portable electric metal shear, 18-gage capacity
- 1—Portable pneumatic metal shear, 18-gage capacity
- 1—Portable power hacksaw
- 1—Portable grinder, 6,000 r.p.m.
- 1—Portable grinder, 4,500 r.p.m.
- 1—Bench vise 6"
- 1—Anvil
- 1—Portable electric spot welder
- 1—44" x 18' steel layout bench

Battery Shop.

- 1—Motor-generator 0-30 amperes, 0-90 volts
- 1—Motor-generator 0-30 amperes, 140 volts
- 1—4" bench vise
- 1—Acetylene torch

Transformer Room.

- 1—Transformer test rack—shop-made

Paint Shop.

- 1—Air filter and regulator
- 3—Paint spray guns
- 1—Drying rack
- 1—Drying oven
- 1—Exhaust fan
- 1—Sink and drain board
- 2—Storage cabinets

Sand Blast House.

- 1—Sand blast, size 50" high, 37" wide, 72" long

Switch Repair.

- 1—12' electric test bench with 8' a.c. and d.c. test panel with voltmeters and ammeters; 1 rectifier with power stat voltage control, 1 small vise, and 3 tool drawers
- Portable meters: 1 industrial circuit tester; 1 a.c. voltmeter, 0-125 volt; 1 a.c. voltmeter 0-300 volt; 1 a.c. milliammeter 0-750; 1 ammeter 0-10 amperes; 1 meter, 0-15 amperes d.c. and 0-150 volts d.c.
- 1—500-volt insulation megger
- 1—250-volt test lamp; 1-coil former
- 1—Pneumatic test bench
- 1—3,500-pound dynamometer
- 1—Electric drill with stand
- 1—Steam cleaner

Sept. 1952]

TABLE 1—Continued

Relay Room.

- 1—Complete test set for 502A C.T.C.
- 1—Complete test set for 504C C.T.C.
- 1—Shop-made test panel for coded relays with electric-driven Veeder counter and motor-driven timer
- 1—Shop-made motor-driven coder with codes of 240, 190, 184, 178, 128, 123, 118 and 75
- 1—On time meter
- 1—0-20 voltmeter
- 1—0-150-1,500 milliammeter
- 1—Volt-ammeter 0-1.5-15-150 volts and 0-0.15-1.5-15 amperes
- 1—Coil winder with turn counter
- 1—7" oscilloscope
- 1—Audio oscillator 7-77,000 cycles
- 1—Weston Model 785 industrial circuit tester
- 2—Volt-ohm-milliammeter meters
- 1—1,000-cycle generator
- 2—Slide resistors for relay tests
- 1—Tube tester
- 1—Vacuum tube voltmeter
- 1—Decibel meter
- 1—0-200 watt-meter
- 1—Deep freeze box, 7.5 cu. ft.
- 1—Bridge for resistance, reactance and capacity, lab. type
- 1—Brush oscillograph
- 1—Floor type $\frac{1}{2}$ " vertical drill press
- 1—Paint booth with 2 guns
- 1—Shop-made test panel for d.c. or a.c. relays, consisting of:
 - 1—Weston Model 155 0-0.050 ampere
 - 1—Weston Model 155 0-0.150 ampere
 - 1—Weston Model 155 0-0.5 ampere
 - 1—Weston Model 155 0-1 ampere
 - 1—Weston Model 155 0-3 amperes
 - 2—G.E.Co. Model 330 0-125 volts
 - 1—Weston Model 1 0-150 volts
 - 1—Weston Model 1 0-0.5 ampere
 - 1—Weston Model 1 0-3,000 ohms
 - 1—Weston Model 1 0-100 ohms
- 1—10" buffer and grinder
- 5—3" bench vises
- 1—0-500 megger
- 5—Benches equipped and wired for a.c. and d.c. as follows:
 - 1—Potentiometer with slide
 - 1—Weston 0-15-150 voltmeter
 - 1—Weston 0-500-1,500 M.A. meter
 - 1—Synchrograph railway tester
 - 1—Square wave generator

Action Recommended
Acceptance as information.

COOPERATIVE REPORT

PURCHASES AND STORES DIVISION, A.A.R.
GENERAL RECLAMATION COMMITTEE*

P. P. Ash, Representative

The General Reclamation Committee has continued its efforts to find ways and means for economically reclaiming materials as well as bringing up-to-date previous Recommended Rules and Practices which will be issued in their consolidated Manual to be known as "A.A.R. Purchases and Stores Division Manual of Reclamation."

As to reclaiming items pertaining to the Signal Section the Committee will report on reclaiming insulated track fittings carrying out A.A.R. Signal Section Specification 216, Manual Part 116, pertaining to assembly and test of insulated track fittings and A.A.R. Signal Section Specification 13 on hard fibre, Manual Part 58.

Action Recommended

Acceptance as information.

* Previous report on this subject appears in A.A.R. Signal Section 1950 Proceedings, Vol. XLVIII, p. 236.

COMMITTEE IV—AUTOMATIC BLOCK SIGNALING

Personnel

E. N. Fox, Chairman
L. B. Yarbrough, Vice-Chairman

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H. Jensen	R. E. Taylor
A. L. Jordan	W. G. Trost
T. H. Kearton	W. L. Waleen

Signal Section, A.A.R.:

The following outline of work has been assigned:

1. Revision of Manual.
2. Indexing signal literature.
3. Report on protection against lightning.
4. Investigate and report on methods of improving shunting of track circuits.
5. Investigate and report on means and methods for the improvement of track circuit rail bonding used in signaling, collaborating with Committees I and V.
6. Investigate and report on the use of automatic block systems, with superimposed control.
7. Investigate and report on the use of track instruments instead of track circuits for the release of electric switch locks and electric locking.
8. Investigate and report on the use of high-voltage lightning arresters—various voltage ranges.
9. Investigate and report on the practicability of in-service tests of all types of lightning arresters.
10. Investigate and report on devices for sanding of rail, or equivalent, which will reduce track circuit shunt failures due to sand, collaborating with Mechanical Division, A.A.R.
11. Investigate and report on the various types of power for operating signaling systems and the operating cost therefor.
12. Performance specification for solderless type connectors for use in wiring signal apparatus (various size conductors).
13. Specification for screw locks and signal padlocks for outside use.
14. Requisites for discharge resistors.
15. Investigate and report on control and ignition for gas switch heaters.

The Committee submits for consideration, reports on the following subjects*:

1. Revision of Specification 83-44, Manual Part 164.
 3. Protection against lightning.
 4. Methods of improving shunting of track circuits.
 5. Performance tests on twist drills for bond holes.
 10. Devices for sanding of rail, or equivalent, which will reduce track circuit shunt failures due to sand.
 15. Electric control of gas switch heaters.
- Cooperative report. American Petroleum Institute Correlating Committee on Cathodic Protection.
- Cooperative report. Communications Section, A.A.R. Committee No. 7—Inductive Coordination.

Information

Specifications, etc., of other organizations referred to in the report of this Committee may be procured from the following:

A.S.A.—American Standards Association, 70 E. 45th St., New York 17, N. Y.
A.S.T.M.—American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.

Disposition of 1951 Letter Ballot Subjects

The following subjects presented by Committee IV at the 1951 Annual Meeting were submitted to letter ballot and officially approved:

- Specification 135-51—Track Circuit Bonding—Now in Manual Part 22.
Formulae for Computing Minimum Allowable Resistance Between Track Battery and Track and for Computing Related Current and Voltage Data—Now in Manual Part 132.
Requisites for Track Circuits—Now in Manual Part 59.
Requisites for Automatic Block Signaling Circuits—Now in Manual Part 34.
Instructions for Minimizing the Effect of Foreign Current on Direct Current Track Circuits—Now in Manual Part 127.
Requisites for Electric Locks Applied to Hand-Operated Switches for Protection of Main Track Movements—Now in Manual Part 211.
Specification 60-51—Installation of Made Ground—Now in Manual Part 92.
Specification 52-51—Low-Voltage Lightning Arresters—Now in Manual Part 95.

* Suggestions or criticisms should be submitted in writing to the Chairman of the Committee on or before September 1, 1952.

PERFORMANCE TESTS ON TWIST DRILLS FOR BOND HOLES

This is a report of a Member Road using twist drills, $\frac{3}{8}$ inch diameter, having a point angle of 118 degrees and lip clearance of 8 to 12 degrees in accordance with Specification 254, Manual Part 259, for drilling in head of rail. They were operated at 250 to 300 r.p.m. in accordance with Instructions for Operation of Power Machines and Drilling of Holes for Rail Bonding, Manual Part 260. The power machines were equipped with collet chucks.

Test No. 1 was conducted with new drills as furnished by manufacturer. The average number of holes per drill was satisfactory but effort was made to determine the cause of the wide variation between individual drills. Inspection of the drills after Test No. 1 showed the chisel edge had rounded over indicating hard spots in the rails, normal with high carbon content, and explains to some extent the variance in the number of holes per drill. Drills 1 and 22, which were removed because of drilling oversized holes, were found to have points slightly off center. All drills were then resharpened by manufacturer for Test No. 2.

The average number of holes per drill in Test No. 2 on the resharpened drills was unsatisfactory. Inspection of the drills after this run showed too much lip clearance and that the cutting edges were not equal in length. It showed chip wash on many of the drills extending all the way across one lip but only near the chisel point on the other cutting edge indicating the point was not central. It also showed a small amount of wear on the back taper due to previous runs.

On the second resharpening, which was also done by manufacturer, it was necessary to shorten the drill to a point where the drills once more had sufficient back taper of approximately 0.005 inch per inch of flute length. Some of the drills had to be shortened about $\frac{1}{4}$ inch to gain this end. On this resharpening, the clearance behind the cutting edge was made 6 to 8 degrees instead of the 8 to 12 degrees as used in Tests Nos. 1 and 2. The drills were carefully checked to insure the point was central and the cutting edges were of equal length. Results of Test No. 3 were very satisfactory.

The improved performance of Test No. 3 is mainly attributed to greater care being used in resharpening of the drills. The decreased lip clearance is not suspected of having considerable influence on the performance; however, the Committee has the matter under further investigation.

It is recommended that Member Roads give careful attention to resharpening and inspection of drills. It is further recommended in the interest of uniformity and better bonding that steps be taken to replace or change their drilling machines to use the collet chucks with Specification 254 drills and eventually make obsolete, drills with flatted and $\frac{3}{32}$ inch shanks.

Results of the tests are shown in Table I.

TABLE I

Drill No.*	Test No. 1	Test No. 2	Test No. 3
	NEW DRILLS Lip clearance 8-12 deg. Holes drilled	FIRST RESHARPENING Lip clearance 8-12 deg. Holes drilled	SECOND RESHARPENING Lip clearance 6-8 deg. Holes drilled
1	10 (a)	47 (c)	226
2	215 (b)	37 (c)	1 (a)
3	254 (b)	30 (c)	350
4	387 (c)	67 (c)	401
5	338 (c)	15 (c)	230
6	235 (b)	15 (c)	401
7	176 (c)	33 (c)	250
8	387 (c)	15 (c)	159
9	164 (c)	39 (c)	230
10	164 (d)	39 (c)	187
11	142 (c)	12 (a)	159
12	225 (e)	110 (c)	220
13	214 (b)	34 (c)	172
14	170 (b)	18 (b)	220
15	0 (f)	41 (b)	42 (e)
16	193 (b)	48 (c)	309
17	224 (e)	1 (a)	226
18	132 (b)	13 (c)	
19	226 (b)	69 (c)	175
20	80 (c)	10 (c)	375
21	33 (c)	64 (b)	172
22	33 (a)	33 (b)	250 (e)
23	175 (c)	46 (b)	309
24	47 (c)	72 (c)	175
25	211 (c)	15 (c)	187
26	211 (c)	47 (c)	375
27	186 (c)	25 (c)	350
28	250 (c)	25 (c)	
29	180 (c)		
30	226 (c)		
Average	189 (29 drills)	36 (28 drills)	237 (26 drills)

Notes:

*Drill numbers in Tests Nos. 2 and 3 correspond but not with Test No. 1.

(a) Replaced because drilling oversized holes.

(b) Replaced because dull and drilling oversized holes.

(c) Replaced because dull.

(d) Replaced because cutting hard and slipping in chuck.

(e) Replaced because machine slipped, breaking drill.

(f) Replaced because cutting point damaged.

Action Recommended

Acceptance as information.

ELECTRIC CONTROL OF GAS SWITCH HEATERS

Electric control, ignition and indication features of gas switch heaters is of considerable interest to the Signal Section because of the increased use of such heaters and the installation, maintenance and operation of the electrical features is generally a signal department responsibility.

The switch heaters under consideration as currently manufactured consist primarily of longitudinal gas burners in sections fixed in a parallel position along both sides of the switch for a length approximating the length of the movable switch points. The series of gas jet flames along the burners are directed along the rails to maintain a temperature in the metal switch structure and closely surrounding air which will melt snow and prevent formation of ice. The gas is supplied from fixed storage tanks or banks of replaceable cylinders, or from mains supplying natural or manufactured gas through a distributing piping system to the burners.

The original installations were generally made in yard or terminal areas, being grouped at locations where employees were in close attendance to observe the functioning of the heaters and prompt maintenance service was available. For these reasons the electrical features were of secondary importance to the operation.

Gas heaters have come into more general use in the past 4 or 5 years, an increased number being installed at remote locations. The electrical features have not been entirely satisfactory. They have required considerable experimenting and development by the railroads and manufacturers towards a more reliable and simpler system. Reports on newer types of electrical features indicate improved performance.

The installation of heaters on traffic control systems where it is desired to turn the heaters on and off at will and also indicate whether the heater is burning or not introduces the most exacting requirements for positive and dependable operation. The performance of the electrical features of these heaters should as near as possible approach the reliability of similar features of traffic control installations. Most remote control installations fall in this same category, particularly if no employees are in the vicinity of the installation to attend or observe and report operation.

The electrical requirements on these heater installations are primarily to open the fuel supply line by means of solenoid valve, ignition of the gas, discontinuance of the ignition current after the heaters are lighted, provision for reignition if the heaters are extinguished and indication that the heaters are burning or not.

At present, two manufacturers are offering heaters with these electrical features. In the past, alternating current operation has been the type most in demand apparently because this was the first type developed and the reluctance of the signal departments to control these heaters from their direct current signal power supply because of heavy current demands, unreliable operation, and apparatus and wiring installations not considered to be in accordance with usual railroad signal practices.

The individual railroad's requirements on the electrical features in the past, while probably necessary in the development stage, have led to numerous arrangements and voltages. Electrical operation is now being provided for

110 or 220 volts a.c. and for 6, 10, 12 and 32 volts d.c. It appears desirable for the manufacturers and the railroads to attempt to arrive at a more uniform arrangement.

One type of solenoid valve originally required 1.5 amperes at 12 volts continuously while the heater was turned on. This was objectionable for direct current sources and has been reduced to 0.33 to 0.5 ampere on more recent installations. Further reduction in current requirements has been obtained by use of a gas pressure switch in combination with the solenoid valve which inserts resistance in series with the solenoid when it has picked up.

The ignition of the gas is accomplished either by a hot wire coil or spark. The hot wire type has provided more reliable operation than the spark type. Condensation of moisture around the spark plug terminal and contacts has been troublesome.

Of the present hot wire igniters, one type has two coils in series, one for each switch rail heater requiring about 7.5 amperes at 12 volts. Another type has the hot coils in parallel, requiring 6 amperes at 6-10 volts. The resistance coils must heat to a temperature of about 1,200 degrees as the gas ignites at 1,000-1,100 degrees. Generally, 10 to 15 seconds operation of the ignition circuit is all that would be required but under adverse conditions it may require about 1 minute to ignite the gas.

In the hot wire type of ignition the current through the hot wire is controlled either by a thermal bimetallic contact attached to the heaters or by a sensitive relay operated from a thermo-couple. The thermo-couple is heated by a pilot light in the ignition housing while the bimetallic contact is heated by an inverted jet of flame from the heater. The hot wire ignition is placed in operation either by a gas pressure switch or circuits through the relay controlling the solenoid valve.

In one type of hot wire ignition the heaters are protected against momentary outages by the use of a coil of iron wire which is kept at white heat by an inverted jet of flame. On outages of an appreciable length of time the bimetallic contact closes and the hot wire coil reignites the gas.

In other types of hot wire ignition the protection against outages is by means of a pilot light burning continuously while the heater is on. On outage of both the heater flames and pilot light the thermal-couple relay de-energizes and the hot wire coil reignites the gas.

The spark type ignition has a spark plug for each heater assembly. The spark plug is fired either by high tension coil or a magneto. In one method, the spark plug is fired by a high tension coil operated from a battery source. The spark is interrupted by an associated electronic timer in cycles of approximately 5 seconds on and 25 seconds off, continuing the cycling operation while the heater is on. The spark ignition apparatus is placed in operation by a pressure switch when the solenoid valve releases the gas into the piping system.

For another method, the spark plug is similarly fired by high tension coil but uses a thermal bimetallic contact on the heater to control the spark. With this type the spark is on only for approximately 10 to 15 seconds or until the gas ignites and causes the thermal bimetallic contact to open. In event of a momentary outage of the heater gas flame, it is reignited immediately by a coil of iron wire which is kept at white heat by an inverted gas flame jet from the heater, which flame is also used in the operation of the bimetallic contact. A gas pressure switch is also used to place this type in operation.

An experimental gas-operated spark igniter has been in use. It uses a magneto instead of a source of battery and a short-time spark is produced every 5 or 6 seconds. When the solenoid is operated to release the gas into the piping system a small portion is diverted through a gas-pressure operated mechanism to drive the magneto as long as the heater is on.

For indication principle, one type has a thermal bimetallic contacting arrangement, one on each switch rail heater under the control of the burner flame. Contacts open to cut off the ignition current and to provide an indication control. Another type provides the same features by means of a thermo-couple under the control of the pilot light for each switch rail heater. The current produced by the thermo-couple operates sensitive relays which in turn cut off the ignition circuit and provide a means for indicating.

The indication of the heaters being lighted for their full length can be made more positive by adding more thermo-couples or thermal bimetallic contacts, or a combination of the two. Some consideration has been given to detection of the heater in operation along each switch rail to be sure it is burning at both ends and in the middle, which to a reasonable degree, guarantees the functioning of the heater for its full length.

Substantial progress has been made by the manufacturers working with individual railroads to improve the operation and dependability of these features; however, the Committee believes other improvements are needed, as follows:

1. In some instances where means are not available to insure a stand-by gas supply, a pressure switch may be necessary to prevent closing of the solenoid valve or ignition circuits unless there is gas to light.
2. Solenoid valve should preferably be made to operate on 8 to 12 volts d.c. at about 0.3 to 0.5 ampere with provisions that when the valve is open the current demand be reduced not to exceed 0.050 to 0.100 ampere or less if possible.
3. Ignition should preferably be by hot wire coils either in series or parallel to operate over an 8 to 12 volt d.c. range with a 6 to 7.5 ampere load for not to exceed 1 minute. Consideration should be given to providing a thermal relay to automatically turn off the ignition current after 1 minute which would stay off until reset by turning the control off and then establishing it again.
4. Ignition circuit should be under control of pilot or burner flame so that reignition will be automatic if burner goes out, providing the control is on and the thermal relay has not shut off the ignition circuit.
5. Reliable and positive indication is very desirable on remote locations because if the heater does not light, the operator must find other means of keeping switches open on short notice.
6. Where vaporizer burners are used on fixed storage tank installations to secure adequate gas pressure from smaller tanks, consideration should be given to providing an indication of the vaporizer pilot light separate from the indication on the switch heater as it is essential that the vaporizer burner operate.
7. The Committee believes that the basic electrical features should be designed for the reliable service demanded by the operation of traffic control systems; however, a simpler arrangement may be used for yard or terminal installations, omitting the indicating features, etc.

Action Recommended

Acceptance as information.

METHODS OF IMPROVING SHUNTING OF TRACK CIRCUITS

Modification of rail head surface by welding stainless steel, bronze or other metal on surface of the head of rail.

At the 1946 Annual Meeting* the Committee reported on tests to improve the shunting sensitivity of track circuits on Railroad P by modification of the rail head surface. The original test installation on main track of 18-8 stainless steel weld metal deposited on top of the rails about $\frac{1}{2}$ inch from gage side by electric welding in 1942 is still in service except where a few rails have been changed out. There has been no spalling out of the stainless steel and the shunting sensitivity of the track circuits remains satisfactory after approximately 10 years of service with average movements of eight engines and two transfers of 30 to 40 cars each per day. The later installations of bronze welding composition used for welding bronze, brass and copper, applied in the same manner as the stainless steel, on infrequently used turnouts are expected to last much longer because of the smaller number of train movements.

Another railroad in October 1948 modified the rail head surface of a little used crossover in a remote-controlled interlocking to insure proper functioning of the detector locking. Stainless steel beads were deposited by electric welding on top of the rails about $\frac{1}{2}$ inch from gage side. These beads were approximately $\frac{1}{8}$ inch in height and 4 inches long with a space of approximately 2 inches between beads. A $\frac{5}{32}$ inch 18-8 316 MO titantic type stainless steel electrode was used. The composition of this electrode consisted of 18 parts chrome, 8 parts nickel, 2 parts molybdenum and small portions of other materials. The crossover is being used an average of six times per day. A recent examination of the beads determined that the wear has been so little in 3 years that these beads are expected to insure satisfactory shunting sensitivity for at least 12 years more, provided the traffic remains approximately the same.

Shunting problem imposed by operation of single unit self-propelled cars equipped with disc brakes.

Single unit self-propelled rail cars equipped with disc brakes are being operated over track circuits in automatic signal, interlocking and traffic control territories on several railroads. It is expected that the use of these cars will be extended because of the operating economies which may be effected thereby. Because these cars are being operated as single units and the wheels may not always be as bright and clean as when clasp-type brakes are used, the shunting of the track circuits may not be reliable, especially when there is frost, snow or moisture on the rails and sand is picked up on the tread of the wheels. A number of cases have been reported in which highway grade crossing protection operated with the car moving away from the crossing due to momentary loss of shunt when passing from the approach to the center track circuit at the crossing, resulting in a loss of the directional feature. Gate tower indicators have cleared and dropped as the car was passing from one track circuit to another. Momentary loss of detector locking at interlockings has occurred due to the leaving track relay picking up before the entering track circuit was

* A.A.R. Signal Section 1945 Proceedings, Vol. XLIII, p. 95.

shunted, particularly at higher speeds. An automatic signal has been known to clear behind the car while it was standing at a station due to automatic application of sand.

The Committee is giving consideration to tests and means for improving the performance of signal facilities where these cars are being operated as single units at various speeds under various weather and temperature conditions. Tests made by some of the railroads with recording instruments and the continuous check of shunting sensitivity on the control machine in traffic control territories has determined that one car may operate the signal facilities satisfactorily when equipped with shoes of proper material and design at proper pressure and position to maintain clean wheels and break through accumulated wheel film while another car, which is apparently identical, causes intermittent failures which require that special precautions be taken. Investigations have been made to determine what the difference in the two cars might be but to date no difference in the physical arrangement of the cars has been found. Experience has determined that the periodic check of a car in any circuit or number of circuits is not conclusive evidence due to the fact that shunting irregularities might occur on one track circuit at one time while in another instance operation in this circuit would be satisfactory with shunting irregularities occurring elsewhere. Therefore, it does not appear that great reliance can be placed on periodic tests with a recording instrument.

Methods under consideration to assist in improving shunting of track circuits for operation of single unit self-propelled cars equipped with disc brakes:

1. Revision of track circuits to provide increased shunting sensitivity.
2. Stagger of insulated joints to be kept at a minimum stagger distance.
3. Mechanical department to maintain wheel cleaning and sanding facilities on these cars in proper condition.
4. Special precautions to be taken in the use of sand or when sand is applied in making a stop.
5. Special operating instructions to be issued for operation on secondary track or branch line equipped with signal facilities where traffic density is light.

It is not yet known whether or not these methods will provide adequate protection, especially at higher speeds.

The Committee will collaborate with the Mechanical Division and the manufacturers of these cars to investigate and report on methods and devices to improve shunting of track circuits.

Full-wave rectified a.c. track circuits for classification yards.

Shunting sensitivity tests which the Committee made on the Pennsylvania R. R. at White Valley, Pa., on October 18 and 25, 1937 to improve shunting of lightweight equipment of the passenger or freight carrying type demonstrated that the rectified a.c.-d.c. track circuit with a full-wave rectifier at the relay and with added resistance between the rectifier and track produced excellent results.

Subsequent tests have demonstrated the superior shunting ability of the rectified alternating current types of track circuits over the conventional types of alternating current track circuits under rail surface conditions adverse to

shunting. The rectified alternating current track circuit may not show any great improvement over the direct current track circuit energized from a 2-volt storage cell under direct shunt obtained by connecting a known resistance from rail to rail but when properly adjusted it provides much greater shunting sensitivity under the rolling shunt test. A rolling shunt is one of variable or intermittent value similar to that obtained when a car is moving over track with rusty or dirty rail surfaces. Rolling shunt tests may be made on track circuits in service by using a clean, plain or galvanized, round iron bar 1 inch or larger in diameter and 6 to 8 feet long rolled slowly along the surface of the two rails and noting its effect on shunting of the track relay.

Sensitive fast shunting is necessary on short track circuits protecting switches in a classification yard equipped with car retarders, as shunting must be effected by a single car. Experience has determined that inter-rail voltages of 6 to 8 volts will provide much greater shunting sensitivity than the usual 2 volts or less.

When alternating current is used, it is easy to obtain 6, 8 or 10 volts, as desired, from the secondary of the track transformer. These alternating current voltages have peak values 1.41 times that read by the voltmeter and these peak values aid in breaking down the rust film.

For detection purposes, the speed of shunting is important. The signal companies have determined that a special direct current track relay, in which the operating current is the same as that of a conventional 4-ohm track relay (0.070 ampere) but in which series resistance has been added in the relay coils to bring the relay resistance up to 28.5 ohms, will shunt in 0.05 second or less when used with 6 to 8 volts on the track circuit described in the foregoing.

The minimum ballast resistance is assumed to be not less than 2 ohms per 1,000 feet or 36 ohms total for a 55-foot track circuit. The resistance of leads to track usually should not exceed 0.2 ohm. With a 16-ohm adjustable resistor between the full-wave rectifier and track and with the secondary voltage of the transformer set at 9 volts, the 16-ohm resistor may be adjusted to provide 6 to 8 volts between rails with 0.170 to 0.175 ampere to the 28.5-ohm relay in the tower with maximum lead resistance of 7 ohms between rectifier and relay. The current to track will not exceed 3.5 amperes under car shunt.

Action Recommended

Acceptance as information.

**DEVICES FOR SANDING OF RAIL, OR EQUIVALENT, WHICH WILL
REDUCE TRACK CIRCUIT SHUNT FAILURES DUE TO SAND***

The report of the Committee's investigation, in collaboration with representatives of the Mechanical Division, A.A.R., of devices for sanding of rail, or equivalent, which will reduce track circuit shunt failures due to sand contained the recommendation that the Specification for Locomotive Sanding System in the A.A.R. Mechanical Division Manual of Recommended Practice be revised and brought up-to-date and that a specification for locomotive sand be included, to avoid excessive build-up of sand on the rails.

Considering that the desired results are effective sanding for traction and braking without sufficient sand build-up on the rails under any condition to cause a false signal indication, the first approach of a Subcommittee of the Mechanical Division Committee on Locomotive Construction was a study of the pattern of the sand delivery obtained with the several sizes of sand pipes and diameters of converging nozzles commonly used. Sand traps from three manufacturers were used in the tests and the tests were of sufficient breadth to develop that the pattern of delivery for a given pipe or nozzle size remains approximately the same through the range of delivery rate that may be used.

The Committee on Locomotive Construction reviewed and revised the Mechanical Division's recommended sanding practice for steam, Diesel-electric and electric locomotives, and the Committee on Specifications for Materials prepared a new specification for car and locomotive sand, as follows:

LOCOMOTIVE SANDING SYSTEM**Steam Locomotives**

Sand pipes to be of 1 inch extra heavy pipe.

Rate of sand delivery per sand pipe per minute:

Engine having one sand delivery per rail, 3 pounds maximum.

Engine having two sand deliveries per rail, $1\frac{1}{4}$ pounds maximum.

Engine having three or more sand deliveries per rail, 1 pound maximum.

Sand pipe or nozzle to be positioned to deliver the sand to the rail over an area 3 inches to 5 inches ahead of wheel contact with rail through to the point of contact. The delivery to be angled slightly inwardly to make maximum contact on the inner half of the rail face having the protection of the wheel flange to reduce the loss.

On drivers equipped with lateral motion device, or lateral cushioning device, sand pipes should be provided with flexible arrangement so that sand pipes can follow drivers when taking curves.

Diesel Locomotives

Sand pipes to be of 1 inch extra heavy pipe.

Rate of sand delivery 1 pound per minute per sand pipe.

* Previous reports on this subject appear in A.A.R. Signal Section 1947 Proceedings, Vol. XLV, pp. 130 and 441 and A.A.R. Signal Section 1949 Proceedings, Vol. XLVII, pp. 120 and 288.

With the sand pipe or nozzle delivery position changing from that when sanding for traction in the brake release position to that when sanding during brake application with fully worn brake shoes, extreme care must be exercised in the application of the sand pipe to provide effective sanding for traction and braking. The sand delivery should be into the wheel contact at rail when brakes are set and with fully worn shoes. This results in delivery over an area 3 inches to 5 inches ahead of wheel contact for traction. The high velocity obtained with the $\frac{5}{8}$ inch or $\frac{1}{2}$ inch converged nozzles results in a more effective rail conditioning and positive delivery of sand.

Electric Locomotives

Sand pipes to be 1 inch extra heavy pipe.

Rate of sand delivery 1 pound per minute per sand pipe.

Diagrams showing recommended sand pipe locations are included in the recommended practice.

SPECIFICATIONS

M-916-51

CAR AND LOCOMOTIVE SAND

1. *Scope.*—These specifications cover a clean sharp silica sand free from clay, loam, mica, and other foreign material, for use in car and locomotive sanding equipment.

Chemical Requirements

2. The solubility of 100 grams of sand immersed in 150 cc. of concentrated hydrochloric acid for 24 hours shall not exceed 5 per cent.

3. *Alternate Method for Determination of Silica in High Silica (90 per cent Minimum) Locomotive Sand.*

(a) Fifteen to twenty grams of the representative sample is ground to pass a 200 mesh sieve.

(b) A one-gram sample is weighed in a tared platinum crucible and heated to a temperature of approximately 1,500 deg. F. for one-half hour. It is then cooled and re-weighed. The loss in weight times 100 gives the percentage of material lost on ignition.

(c) To the weighed residue in the crucible add 4 drops of distilled water, 2 drops concentrated sulphuric acid (1.84 specific gravity) and 10-15 cubic centimeters of pure hydrofluoric acid and then evaporate to dryness. The crucible is then rotated carefully, using crucible tongs, over an open gas flame to avoid splattering until all sulfur trioxide fumes have been expelled, after which the crucible is blasted for a minute, cooled and re-weighed. The loss in weight times 100 gives the per cent of silica in the sand.

(d) For sands containing less than 90 per cent of silica, the usual chemical fusion method should be used for the silica determination.

Physical Requirements

4. *Caking Test.*—The sand shall have satisfactory non-caking properties as determined by the following test: A cylinder not less than 11 inches high and 1 inch in diameter shall be filled with the sand after the sand has been saturated with distilled water. After drying in an oven at 100 deg. C. for 12 hours, it shall run freely through an opening of $\frac{1}{2}$ inch in the bottom of the container without shaking or tapping.

5. *Grading.*—The sand shall meet the following grading requirements:

	Min.	Max.
Percentage passing U.S. Standard Sieve No. 10.....	100	—
Percentage passing U.S. Standard Sieve No. 30.....	40	—
Percentage passing U.S. Standard Sieve No. 50.....	10	30
Percentage passing U.S. Standard Sieve No. 80.....	—	5

6. *Sampling.*—A 25-pound sample representing each carload may be taken either at destination or at the plant.

Inspection and Rejection

7. *Inspection.*

(a) The inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the material ordered. The manufacturer shall afford the inspector, free of charge, all reasonable facilities and necessary assistance to satisfy him that the material is being furnished in accordance with these specifications. Tests and inspection at the place of manufacture shall be made prior to shipment unless otherwise specified.

(b) The purchaser may make tests to govern the acceptance or rejection of the material in his own laboratory or elsewhere. Such tests shall be made at the expense of the purchaser.

8. *Rejection.*

(a) Material represented by samples which fail to conform to the requirements of these specifications will be rejected.

(b) Material which shows injurious defects subsequent to its original inspection and acceptance at the manufacturer's works, or elsewhere, will be rejected, and the manufacturer shall be notified.

9. *Rehearing.*

(a) Samples tested in accordance with these specifications which represent rejected material, shall be held for a period of 14 days from date of the test report. In case of dissatisfaction with the results of the tests, the manufacturer may make claim for a rehearing within that time.

The above recommendations for sanding practice and sand were accepted for submission to letter ballot at the 1951 Annual Meeting of the Mechanical Division, A.A.R. on June 26-28, 1951. The recommendations subsequently received letter ballot approval of the members and are now a part of the recommended practice of the Mechanical Division.

It is the opinion of Signal Section Committee IV that any complaints regarding excessive sand build-up on rails may be corrected by the exercise of reasonable care regarding a fair quality of sand preferably to the coarse side of the sieve range; sand pipes or nozzles of diameter to provide a high velocity delivery; positioning of delivery nozzles to insure effective delivery of sand to point of wheel-rail contact; and maintenance of sand trap adjustment to approximately the recommended delivery rates.

Action Recommended

Acceptance as information.

(Revision of A.A.R. Signal Section Specification 83-44)
A.A.R. SIGNAL SECTION SPECIFICATION 83-52.

TRANSFORMER, DRY-TYPE SELF-COOLED

1. *Purpose.*

(a) This specification is for the purpose of providing for a dry-type single-phase transformer up to 660 volts, cooled by natural circulation of air. It sets forth specific detail requirements representing modern signal practice recommended for new installations and for replacement on existing installations when general renewal or replacement becomes desirable.

2. *Requisites, specifications, standards and drawings.*

(a) Requisites, specifications, standards and drawings referred to in the body of this specification form an essential part hereof.

(b) Manufacturer shall furnish with his tender, drawings forming an essential part thereof.

3. *Tender.*

(a) The tender shall be for a product meeting the requirements of this specification in its entirety.

4. *Purchaser's order requirements.*

(a) The following additional requirements will be shown on the Purchaser's order:

1. Total kv-a. rating.
2. Frequency.
3. Primary voltage.
4. Number of secondaries and purpose of each.
5. Output in volts and amperes and power factor of each secondary.
6. Total voltage of each secondary and tap voltages, if any.
7. Indoor or outdoor service.
8. Wall, shelf, or cross-arm mounting.
9. Service conditions, if outside the limits shown in section 7-a.
10. Inspection and tests as required.
11. Alternate requisites as required.

5. *Alternates.*

(a) The provisions contained in the alternate requisites section of this specification form a part hereof only when substituted by Purchaser's order for the provisions contained in this specification.

6. *Material and workmanship.*

(a) Material and workmanship shall be first-class in every respect.

7. *Service conditions.*

(a) Equipment conforming to this specification shall be suitable for operation at its rating provided that:

1. The temperature of the cooling air (ambient temperature) does not exceed 104 deg. F. and the average temperature of the cooling air for any 24-hour period does not exceed 86 deg. F.
2. The altitude does not exceed 3,300 ft.

8. *Type.*

(a) Transformer shall be designed for indoor or outdoor service, as specified.

(b) Transformer shall be designed for cross-arm, wall or shelf mounting, as specified.

9. *Windings.*

(a) Track, lighting and rectifier transformers shall have their primaries wound for 57.5 volts or even multiples thereof up to 575 volts. The voltage and frequency shall be specified. The primary shall have a 13 per cent tap to compensate for reduced voltage.

(b) Insulating and line transformers shall have primary wound for voltage and frequency specified.

(c) Line transformers shall be provided with percentage taps to compensate for reduced voltage if and as specified.

(d) Compensating taps shall be for full rated kv-a.

(e) The number of secondaries, their purpose, voltage taps, v.a. rating and power factor of each shall be as specified.

(f) Voltages specified shall be based on full-load operation at the power factor specified.

(g) All windings shall be insulated from each other.

10. *Rating.*

(a) Transformer shall have a continuous kv-a. rating equal to the sum of the ratings of all the secondaries.

11. *Frequency.*

(a) Transformer shall be designed for the frequency specified.

12. *Core.*

(a) The core shall be non-aging laminated sheet steel so assembled that no buzzing is perceptible.

(b) The steel shall be considered non-aging provided the percentage change in core loss does not exceed 2 per cent after subjecting the steel to a continuous temperature of 212 deg. F. for a period of 30 days.

13. *Insulation.*

(a) Windings shall be wound with one of the following types of insulated wire and treated so as not to be injuriously affected

13. *Insulation.*—Continued.

by atmospheric conditions or by changes in temperatures between 40 deg. F. below zero and 185 deg. F. above zero. *R-13-a.

1. Cotton-covered wire shall be in accordance with Specification 194, Manual Part 189.

2. Enameled wire shall be in accordance with Specification 193, Manual Part 183, and shall have an additional covering consisting of a layer of cotton, silk or equivalent.

(b) Windings shall be impregnated by vacuum and pressure with insulating compound in accordance with Requisites for Compound for Impregnation of Electrical Windings, Manual Part 171. *R-13-b.

(c) Insulating material used for fillers in winding shall be chemically neutral.

(d) Material used for insulation shall be such that in the completed transformer it will not be injuriously affected by atmospheric conditions.

14. *Leads and terminals.*

(a) Transformers for outdoor service shall be provided with leads of insulated flexible copper wire. Primary leads shall project not less than 36 in. and secondary leads not less than 12 in. beyond the housing of transformer. They shall be of a cross-section not less than that of the winding to which they connect, and in no case less than No. 14 A.W.G. They shall be so secured as to prevent strain coming on the connections to coils.

(b) Transformers for indoor service shall be provided with terminal boards made of molded insulation, ebony asbestos wood or other equally suitable material of thickness sufficient to prevent warping or damage in shipment. Terminal boards shall be so located as to be easily accessible.

1. Leads from windings rated 175 volts or less shall be brought to binding posts uniformly arranged on the terminal board.

2. Leads from windings rated more than 175 volts shall be not smaller than No. 14 A.W.G. flexible insulated wire and brought through the terminal board or housing and so secured as to prevent strain coming on the connections to windings, except that for windings not exceeding 250 volts the leads may be brought to binding posts on the terminal board. When used, leads shall project not less than 12 in. beyond terminal board or housing and shall be provided with suitable connectors to permit ready connection and taping of joint. *R-14-b-2.

(c) On transformers having exposed leads between winding and terminal board, if the winding conductor is of smaller cross-

* Alternate requisites section.

14. *Leads and terminals.*—Continued.

section than No. 14 A.W.G., a flexible conductor of not less than No. 16 A.W.G. conductivity shall be used.

(d) On totally enclosed transformers for indoor service where winding conductor is of smaller cross-section than No. 18 A.W.G. a flexible conductor of a conductivity of not less than No. 18 A.W.G. shall be used between winding and binding post.

(e) Binding posts, nuts and washers shall conform to Drawing 1070, assembly 107010.

(f) Binding posts shall be mounted so they cannot be turned in the base or frame to which applied. They shall be properly insulated from each other and other metallic parts.

15. *Polarity of windings.*

(a) The instantaneous external polarities of windings shall be indicated by plainly marking the relative positive and negative leads from each winding. They shall be determined as follows:

1. The positive terminal of the primary winding shall be arbitrarily indicated.
2. The positive terminal of a secondary winding will then be that terminal from which current is flowing out to the load at the instant when current is flowing into the positive terminal of the primary winding.

(b) All transformers of a given type and manufacture shall be so arranged that the instantaneous polarities of corresponding leads are alike.

16. *Name plate and diagram.*

(a) A name plate shall be securely fastened to each transformer and shall give the following information:

1. Name and address of Manufacturer.
2. Total kv-a. rating.
3. Frequency.
4. Primary voltage.
5. Total voltage of each secondary winding.
6. Serial number.
7. Manufacturer's reference number.

(b) Information showing the ampere capacity of each secondary, the full-load voltage and tap voltages of each winding and the relative instantaneous polarities of the leads shall be shown on a diagram or tag attached to each transformer, or, where practicable, this information may be marked on terminal board.

17. *Housing.*

(a) Housings for transformers for outdoor service shall be weather-resisting and so designed as to afford moisture and mechanical protection to the windings.

18. *Dielectric requirements.*

(a) Assembled transformer shall withstand for 1 minute a 60-cycle insulation test, at place of manufacture, of 3,000 volts between each winding and other metallic parts insulated therefrom, except where specified otherwise.

(b) Transformer winding rated more than 175 volts shall withstand for 1 minute a 60-cycle insulation test at place of manufacture of 10,000 volts between such winding and other metallic parts insulated therefrom, except that windings rated more than 175 volts but less than 250 volts may, when designed to be connected to a local line or load, be tested to withstand 3,000 volts.
*R-18-b.

(c) When a secondary has an associated adjusting secondary, the insulation between them shall withstand for 1 minute a 60-cycle insulation test, at place of manufacture, of 500 volts.

(d) A surface leakage distance sufficient to withstand dielectric tests in sections 18-a and b shall be provided between any exposed metallic part of the apparatus carrying current and any other metallic part thereof. Surface leakage distance shall be not less than $\frac{3}{8}$ in.

(e) A potential of twice the normal operating requirements at a suitable frequency shall be impressed across the windings for 1 minute, without any excessive flow of current indicating a short circuit.

19. *Tests.*

(a) Tests may be made at point of production, or on samples submitted, and may also be made at destination.

(b) Manufacturer shall give the Purchaser sufficient notice of time when the material or product will be ready for testing.

(c) Manufacturer shall provide, at point of production, apparatus and labor for making required tests under supervision of the Purchaser.

(d) If tests are to be made at point of production, it shall be so stated on Purchaser's order. The Purchaser shall indicate which of the tests herein specified are to be made and what portion of the material or product shall be tested.

(e) The following tests may be required by Purchaser on all transformers:

1. Exciting current.
2. No-load voltage ratio.
3. Polarity.
4. Dielectric strength.
5. No-load loss.

(f) Unless otherwise specified, the following tests† shall not be required when a record of tests made on two transformers, dupli-

* Alternate requisites section.

† Charge may be made for these tests.

19. *Tests.*—Continued.

cates or essentially duplicates of the type and rating specified can be furnished:

1. Regulation.
2. Temperature rise.
3. Load losses.
4. Full-load voltage ratio.

20. *Description of tests.*

(a) Exciting current.

1. The average exciting current shall not exceed the following percentage of full-load current:

V.A. rating	25-cycle	60-cycle	100-cycle
Up to 100.....	25	15	12
101 to 200.....	15	10	10
Over 200.....	10	10	10

(b) No-load voltage ratio.

1. This test shall be made with rated voltage applied to primary and with secondaries on open circuit.

(c) Full-load voltage ratio.

1. The full-load voltage ratio of the transformer shall be checked by impressing the rated voltage and frequency on the primary winding and reading all secondary voltages with all secondaries delivering their rated load at specified power factor. The value obtained shall not vary more than 2 per cent, plus or minus, from the values given on the voltage diagram and Purchaser's order.

(d) Polarity.

1. Polarity of all transformers shall be checked as follows:

(a) Connect the indicated positive terminal of one winding to the indicated negative terminal of another winding until all the windings are in series, impressing the rated voltage across the terminals of the primary winding. The voltmeter connected between the two ends of all the windings in the series shall read the sum of all their voltages.

(e) Dielectric strength.

1. Tests shall be made in accordance with sections 18-a, b, c and e.

(f) No-load losses.

1. No-load losses and exciting current shall be taken at any convenient ambient air temperature, preferably not less than 59 deg. F.

2. No-load losses shall be measured with watt-meter at normal frequency and voltage using power from generator giving sine wave, where such is available. When a pure sine

20. *Description of tests.*—Continued.

wave is not available it shall be permissible to use any wave form which comes within the A.S.A. definition of sine wave, adjusting the voltage so that the no-load losses will be the same as with normal voltage and sine wave.

3. Where voltage cannot be regulated by excitation of the generator it shall be done with auto-transformer and not by rheostat in series with the transformer to be tested. The average of the no-load losses of the transformers tested shall not exceed the value specified in section 20-h and the maximum no-losses shall in no case exceed the value given in section 20-h by more than 10 per cent.

(g) Load losses.

1. Load losses shall be determined by watt-meter in accordance with A.S.A. Standard for load losses and the average of the load losses of the transformers tested shall not exceed the value specified in section 20-h and the maximum load losses shall in no case exceed by more than 10 per cent the specified values given in section 20-h.

(h) No-load and load losses.

1. The no-load and load losses shall not exceed the figures shown in the following table except as provided in sections 20-f and g:

V.A. rating	No-load losses, per cent	Load losses, per cent	Total losses, per cent
Up to 50.....	6	14	20
51 to 200.....	5	10	15
201 to 500.....	4	8	12
501 to 1,000.....	2½	5½	8
Over 1 kv-a.....	2	4	6

(i) Regulation.

1. With no load the voltage of each of the windings shall not exceed the unity power factor load values specified by more than 10 per cent. This test shall be made at any convenient temperature and corrected to a reference temperature of 167 deg. F.

2. When calculated, the regulation for either the whole or part of the transformer shall be computed from measured resistance and the reactance drop of voltage using the method as given in the A.S.A. Standards.

(j) Temperature rise.

1. Two transformers of each new design shall be tested for temperature rise.

2. When tested for temperature rise, transformers may be overloaded and over-excited to hasten the rise of temperature to the ultimate value under normal load, and final temperature in any part maintained for 1 hour under con-

20. *Description of tests.*—Continued.

stant full load and normal voltage and frequency shall not exceed the temperature of the room more than 99 deg. F. The rise of temperature shall be determined by the increase of resistance of the windings by the methods given in A.S.A. Standards and shall be checked by thermometer placed as directed by representative of Purchaser.

21. *Inspection.*

(a) Purchaser may inspect the material or product at all stages of manufacture.

(b) Purchaser may inspect the completed product to determine that the requirements of this specification have been met.

(c) If product has not been accepted at point of production and if, upon arrival at destination, it does not meet the requirements of this specification, it may be rejected, and the Manufacturer, upon request, shall advise the Purchaser what disposition is to be made of the rejected product. Manufacturer shall pay all freight charges.

(d) If Purchaser is to make inspection at point of production it shall be so stated on Purchaser's order.

22. *Packing.*

(a) Product shall be so assembled or packed as to permit convenient handling and to protect against loss or damage during shipment.

23. *Marking.*

(a) Purchaser's order, requisition and package number, name of Consignor, and name and address of Consignee, shall be plainly marked on outside of packages.

(b) Detail list of packages and their contents shall be furnished for each shipment. Where carload shipments are made, routing and car identification shall be shown.

24. *Warranty.*

(a) Manufacturer shall warrant the product covered by this specification to be free from defects in material and workmanship under ordinary use and service, his obligation under this warranty being limited to manufacturing, at point of production, any part or parts to replace those which shall be found defective within 1 year after shipment to the Purchaser. This warranty shall not apply to any product which shall have been repaired or altered in any way by anyone other than the Manufacturer thereof, so as to affect, in the Manufacturer's judgment, its proper functioning or reliability, or which has been subjected to misuse, negligence or accident.

Alternate requisites.

R-13-a.

Windings shall be wound with one of the following types of insulated wire and treated so as not to be injuriously affected by atmospheric conditions or by changes in temperatures between 40 deg. F. below zero and 185 deg. F. above zero:

1. Enameled wire shall be in accordance with Specification 193, Manual Part 183.
2. Wire covered with.....insulation.

R-13-b.

Windings shall be impregnated by vacuum and pressure with insulating varnish in accordance with Requisites for Varnish for Treatment of Electrical Windings, Manual Part 174.

R-14-b-2.

Leads from windings rated volts or less shall be brought to binding posts uniformly arranged on the terminal board.

R-18-b.

Transformer winding rated more than volts and not exceeding volts shall withstand for 1 minute a 60-cycle insulation test at place of manufacture of volts a.c. between such winding and other metallic parts insulated therefrom.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Specification 83-44—Transformer, Dry Type, Self-Cooled,
Manual Part 164.

PROTECTION AGAINST LIGHTNING*

Previous reports on this subject have emphasized that the use of discharge resistors represents the best method of inter-connecting the lightning arrester ground system with the track.

A careful reconsideration of the replies to questionnaire (Inquiry SS-85A), referred to on page 143 of A.A.R. Signal Section 1949 Proceedings, Vol. XLVII, indicates an extensive use of low-voltage arresters that are in accordance with Specification 52, Manual Part 95, rather than discharge resistors for this purpose.

Obviously, the successful use of the low-voltage arresters indicates that there are many locations where a lesser degree of protection than would be obtained with discharge resistors is practical.

The Committee at this time presents revised Fig. 1, but wishes to direct attention to the following limitations:

Conventional signal arresters when used as track arresters may not be satisfactory because they do not pass surge currents until spark-over occurs at the gap and since simultaneous spark-over probably will not occur in each arrester, a surge voltage may occur between rails and across the track circuit apparatus.

These arresters are not designed for a discharge capacity which will carry the sum of the currents which may sometimes occur when several signal arresters and primary arresters discharge their combined lightning and power-follow current to the track rails.

* Previous report on this subject appears in A.A.R. Signal Section 1949 Proceedings, Vol. XLVII, pp. 142 and 290.

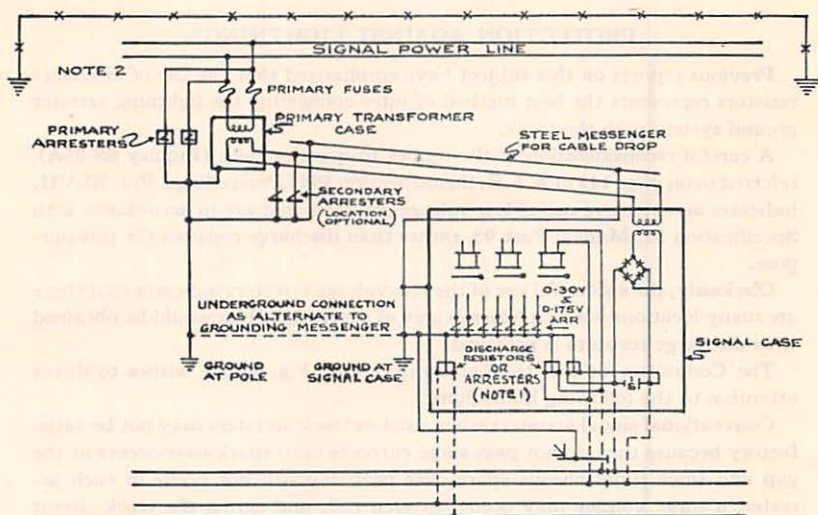


FIG. 1

---x---x---x--- = OVERHEAD GROUND WIRE EXTENDING SEVERAL POLES
EITHER SIDE OF TRANSFORMER LOCATION

Notes for Fig. 1.—

1. (a) Discharge resistors as shown should be used to give the most effective protection. They must have an inverse resistance-current characteristic so that they will not pass an appreciable amount of current at signal voltages but will pass large amounts of lightning discharge currents with relatively low IR drop.

1. (b) Where a maximum degree of protection is not required, low-voltage arresters which are in accordance with Specification 52, Manual Part 95, may be used in place of discharge resistors. They must be installed between each rail lead and the common ground bus.

2. Overhead ground wire extending several poles either side of transformer location. Overhead ground wire or shield should have 8 feet or more vertical clearance from all power and signal wires. Down leads from shield wire should have 4 feet 3 inches or more clearance from all other wires and the grounds should not be closer than 10 feet to any other ground or buried conductor. Net resistance of the shield wire grounds in multiple should not exceed 4 ohms.

3. Additional protective devices may be required, depending upon the types of circuits and apparatus employed. For example, an arrester is frequently connected as a shunt across track leads as additional protection for track circuit apparatus.

Action Recommended

Acceptance as information.

COOPERATIVE REPORT

AMERICAN PETROLEUM INSTITUTE
CORRELATING COMMITTEE ON CATHODIC PROTECTION

R. B. Amsden, Representative

A. B. Armistead, Alternate

In the 1951 Annual Meeting Advance Notice*, a progress report outlined the activities of the Correlating Committee on Cathodic Protection, in which representatives of 10 national industry organizations and an engineering association have cooperated, under sponsorship of the American Petroleum Institute, to prepare and disseminate information about cathodic protection of buried metallic structures, its beneficial use and the necessity for cooperation in dealing with it to avoid stray current interferences with neighboring structures.

Four bulletins which were drafted by the Correlating Committee on Cathodic Protection and released between February 1948 and March 1951 have been consolidated and edited to minimize duplications. The consolidated booklet, entitled "Cathodic Protection—Report of Correlating Committee on Cathodic Protection" was published in October 1951 and has been given fairly wide initial distribution. Copies of this report may be obtained at nominal cost by application to the National Association of Corrosion Engineers, Room 919, Milam Building, Houston, Tex.

Action Recommended

Acceptance as information.

COOPERATIVE REPORT

COMMUNICATIONS SECTION, A.A.R.
COMMITTEE NO. 7—INDUCTIVE COORDINATION†

E. N. Fox, Consulting Member

The following report of interest to the Signal Section was presented at the 1951 Annual Meeting of the Communications Section, A.A.R. and accepted as information by that Section:

TRANSPPOSITIONS IN SIGNAL SUPPLY CIRCUITS

A-1. The committee finds that there is no uniformity of practice in the application of transpositions to alternating current signal supply circuits on pole lines used jointly with communication circuits.

* A.A.R. Signal Section 1950 Proceedings, Vol. XLVIII, pp. 179 and 385.

† Previous report on this subject appears in A.A.R. Signal Section 1949 Proceedings, Vol. XLVII, pp. 152 and 293.

A-2. On some railroads, no transpositions are used. On others, they are used to a degree which varies between wide limits and may not be the same on various parts of the same railroad. On other railroads, transpositions are installed only when the need for them has become apparent. It is extremely difficult to determine when transpositions are needed, as alternating current signal supply circuits are usually completed in small increments and the inductive effects are then cumulative over a period of time and not readily identified.

A-3. It is the recommendation of the committee that transpositions be installed on new construction, major rearrangements, or extension of existing a-c signal supply circuits.

A-4. Where signal supply circuits are located on the communication pole line, either above the communication circuits, or below, on the end pins of a communication-type crossarm, these transpositions should be located as follows:

(a) For E-sections, at the odd $\frac{1}{8}$ ths of the communication transposition scheme.

(b) For L-sections at the odd $\frac{1}{4}$ ths.

(c) For U-sections: None for a single U-section. When there is a series of consecutive U-sections, one supply circuit transposition located at a US pole, approximately at the center of this series of consecutive U-sections.

A-5. Major discontinuities in the signal supply circuit should in general occur at balance points in the communication transposition scheme. When this is impractical, special transpositions in the supply circuit should be installed so as to secure adequate balance between the supply and communication circuits.

A-6. Major discontinuities in the supply circuit are: The power feed point, change in pin position of the supply circuit, change in crossarm spacing, between signal and communication arm, of one gain or more.

A-7. Minor discontinuities which do not have to be taken into account are: Load transformers, disconnecting switches, and end of supply circuit.

A-8. Transpositions in the signal supply circuit may be running transpositions.

A-9. Where signal supply circuits are located on pole line on opposite side of track, in general, no transpositions are necessary in the supply circuit.

Note: Certain types of a-c track circuits require that proper polarity (phasing) of the a-c be maintained at the signal locations. In such cases, when adding transpositions to the supply circuit, this phasing should be checked and corrected if necessary.

A-10. In special cases, where local conditions require, additional transpositions in the signal supply circuit may be found necessary to control existing interference.

B—Coded Track Circuits

B-1. There are certain types of "coded track circuits" in which the current in the track circuit (the two rails) is interrupted at various frequencies. Usually two codes are used: 75 and 180 per minute, representing two respective signal indications. When there is a train in the circuit, short-circuiting the rails, this track current rises to fairly sizable value, and has been known to cause noise interference in paralleling telephone circuits. Such interference has been, and usually can be, taken care of by adding spark-killers to the signal code transmitting relays and it is the recommendation of this committee that it be taken care of in this manner by the Signal Department or Signal Manufacturer.

Action Recommended

Acceptance as information.

COMMITTEE V—CONTRACTS AND INSTRUCTIONS

Personnel

E. B. Platt, Chairman

F. Youngwerth, Vice-Chairman

W. Abell	A. T. Hunot
G. D. Booth	J. G. Karlet
L. C. Brown	F. M. Kunker
W. N. Donahue	C. L. Ott
R. C. Dueland	J. A. Phillips
A. C. Eastman	E. L. Rogers
O. Falkenstein	G. C. Schindler
E. W. Hastings	W. L. Scott
I. D. Hesler	S. P. Searle

Signal Section, A.A.R.:

The following outline of work has been assigned:

1. Revision of Manual.
2. Indexing signal literature.
3. Instructions for testing signal installations before placing in service.
4. Instructions for electric locks applied to hand-operated switches.
5. Forms for reporting progress of the component parts of new signal installations and expenditures for labor.
6. Investigate and report on a simplified system of numbering and identification of wires and circuits which does not require the changing of nomenclature and tags on wayside circuits when a minor change is made.
7. Investigate and report on the use of portable induction type telephones by signal forces.
8. Specification covering an instrument for determining ground resistance.
9. Recommend uniform practice in reporting track circuit rail bond failures under I.C.C. classifications, collaborating with Committees I and IV.

The Committee submits for consideration, reports on the following subjects*:

1. Revision of Definitions for Technical Terms Used in Signaling, Manual Part 55.
- Revision of Specification 112-46, Manual Part 3.
- Revision of Instructions for Resistance of Made Grounds, Manual Part 61.
- Revision of Specification 85-46, Manual Part 168.
- Revision of Specification 115-46, Manual Part 169.
- Revision and Consolidation of Instructions for Non-Coded Direct Current Track Circuits, Instructions for Non-Coded Alternating Current Track Circuits, and Instructions for Coded Direct Current Track Circuits, Manual Parts 8, 162 and 218.

* Suggestions or criticisms should be submitted in writing to the Chairman of the Committee on or before September 1, 1952.

Revision of Instructions for Copper-Oxide Caustic Soda Primary Cells, Manual Part 7.

Revision of Instructions for Car Retarder Systems, Manual Part 125.

Revision of Instructions for Insulation Resistance, Manual Part 130.

Revision of Instructions for Facing Point Locks Applied to Spring Switches, Manual Part 159.

4. Instructions for Electric Switch Locks.

6. Simplified system of numbering and identification of wires and circuits which does not require the changing of nomenclature and tags on wayside circuits when a minor change is made.

Cooperative report. American Standards Association—Definitions of Electrical Terms—Project C42—Subgroup 8.

Information

Specifications, etc., of other organizations referred to in the report of this Committee may be procured from the following:

A.I.E.E.—American Institute of Electrical Engineers, 33 W. 39th St., New York 18, N. Y.

A.S.A.—American Standards Association, 70 E. 45th St., New York 17, N. Y.

Disposition of 1951 Letter Ballot Subjects

The following subjects presented by Committee V at the 1951 Annual Meeting were submitted to letter ballot and officially approved:

Definitions for Technical Terms Used in Signaling—Now in Manual Part 55.

Specification 257-51—Ground Resistance Testing Instrument—Now in Manual Part 103.

Instructions for Automatic Block Signal Systems—Now in Manual Part 102.

Instructions for Interlockings—Now in Manual Part 59.

Instructions for Signal Protection for Movable Bridges—Now in Manual Part 233.

Instructions for Light and Semaphore Signals—Now in Manual Part 54.

Instructions for Time Releases Applied to Signal Apparatus—Now in Manual Part 128.

Instructions for Switch Circuit Controllers—Now in Manual Part 134.

Instructions for Electric Locking—Now in Manual Part 199.

(Revision of Definitions for Technical Terms Used in Signaling)
A.A.R. SIGNAL SECTION DEFINITIONS.

TECHNICAL TERMS USED IN SIGNALING

1952

Back Light, Highway Crossing Signal. (Revision of "Back Light")

An auxiliary signal light used for indication in a direction opposite to that provided by the main unit.

Back Light, Signal. (New)

The light from a signal electric lamp visible through a small opening in the back of a light signal, used for checking the operation of the signal lamp.

Battery, Floating. (Revision)

A storage battery which is kept in operating condition by a continuous charge at a low rate or primary battery coupled with a rectifier to provide a supplementary source of energy.

Bond, Impedance. (Revision)

An iron core coil of low resistance and relatively high reactance, used on electrified railroads to provide a continuous path for the return propulsion current around insulated joints and to confine the alternating current signaling energy to its own track circuit.

Brake Shoe, Retarder. (New)

See definition for Shoe, Brake; Retarder.

Car Retarder System. (New)

A system designed to control car movements comprising car retarders together with such yard switch machines, skate machines, hump signals, and trimmer signals as may be required and necessary control facilities.

Classification Yard. (New)

See definition for Yard, Classification.

Controller, Hump Signal. (New)

A device located at the hump which includes the hump signal control lever and may also include the trimmer signal control lever and signal repeater lights.

Device, Focusing. (Revision)

An instrument used to locate the filament of an electric lamp at proper focal point of lens or reflector systems.

Filter, Wave. (New)

A device for separating waves on the basis of their frequency. It introduces relatively small insertion loss to waves in one or more frequency bands and relatively large insertion loss to waves of other frequency.

Filter, Electric Wave. (New)

A wave filter designed to separate electric waves of different frequencies.

Filter, Low Pass. (New)

A wave filter having a single transmission band extending from zero frequency up to some critical or cut-off frequency, not infinite. (A.I.E.E.)

Filter, High Pass. (New)

A wave filter having a single transmission band extending from some critical or cut-off frequency, not zero, up to infinite frequency. (A.I.E.E.)

Filter, Band Pass. (New)

A wave filter which has a single transmission band, in which the critical or cut-off frequencies are neither zero nor infinite.

Filter, Band Elimination. (New)

A wave filter which has a single attenuation band, in which the critical or cut-off frequencies are neither zero nor infinite.

Filter, Direct Current and Voice Pass. (New)

A low pass filter that passes direct current and voice frequencies and attenuates the frequencies above the voice range.

Filter, Low Pass Code. (New)

A low pass filter connected between coding equipment and line to pass direct current code impulses and prevent code equipment from shunting carrier and communication circuits. It prevents line coding contacts from introducing undesired high frequency currents into the line.

Filter, Direct Current, Voice and Type H Pass. (New)

A low pass filter that passes direct current, voice frequencies and Type H carrier frequencies, and attenuates frequencies above the Type H range.

Filter, Code. (New)

See definition for Filter, Low Pass Code.

Filter, Voice and Carrier Pass. (New)

A high pass filter that passes voice frequencies and carrier frequencies and attenuates frequencies below the voice range.

Filter, Voice and Type C Pass. (New)

A band pass filter that passes voice and Type C carrier frequencies and attenuates frequencies below the voice range and above the Type C range.

Filter, Voice Pass. (New)

A band pass filter that passes voice frequencies and attenuates frequencies above and below the voice range.

Filter, Voice and Type H Pass. (New)

A band pass filter that passes voice and Type H carrier frequencies and attenuates frequencies below the voice range and above the Type H range.

Filter, Receiving. (New)

A band pass filter associated with the input circuit of a carrier receiver or repeater.

Filter, Transmitting. (New)

A band pass filter associated with the output circuit of a carrier transmitter or repeater.

Hump. (Revision)

See definition for Yard, Hump.

Hump Signal. (New)

See definition for Signal, Hump.

Hump Signal Controller. (New)

See definition for Controller, Hump Signal.

Machine, Control; Car Retarder System. (New)

See definition for Machine, Control.

Machine, Skate. (New)

A mechanism electrically controlled and electrically or pneumatically operated, for placing a skate on, or removing it from, the rail.

Machine, Switch; Yard. (New)

A quick acting device electrically controlled and electrically or pneumatically operated, for positioning track switch points, and so arranged that accidental trailing of the switch points does not cause damage.

Receiver, Carrier. (New)

An electronic device for receiving predetermined carrier frequencies and converting them to suitable form for operation of associated devices.

Repeater, Carrier. (New)

An electronic device inserted in a carrier circuit, usually to amplify carrier voltages to compensate for losses occurring in transmission.

Retarder Shoe. (New)

See definition for Shoe, Brake; Retarder.

Shoe, Brake; Retarder. (New)

The expendable wearing part of a car retarder for applying braking pressure to car wheels.

Shoe, Retarder. (New)

See definition for Shoe, Brake; Retarder.

Signal, Flashing Light. (Revision)

A highway crossing signal, the indication of which is given by two horizontal red lights flashing alternately at predetermined intervals or a fixed signal in which the aspects are given by color and by the flashing of one or more of the signal lights.

Signal, Four-Position. (Revision)

A light signal unit arranged to provide four aspects.

Signal, Highway Crossing. (Revision)

An electrically operated signal used for the protection of highway traffic at railroad-highway grade crossings.

Signal, Hump. (New)

A signal located at the summit in a hump yard which gives indication concerning movement to the classification tracks and indicates to the engineman the desired direction and speed of movement of his train.

Signal, Three-Position. (Revision)

A semaphore arm or a light signal unit arranged to provide three aspects.

Signal, Trimmer. (New)

A signal located at the summit in a hump yard, which gives indication concerning movements from the classification tracks toward the summit.

Signal, Two-Position. (Revision)

A semaphore arm or a light signal unit arranged to provide two aspects.

Skate. (New)

A sliding device placed on a rail to engage with a car wheel so as to provide continuous braking by sliding friction.

Skate Machine. (New)

See definition for Machine, Skate.

Switch Machine, Yard. (New)

See definition for Machine, Switch; Yard.

Switching, Automatic. (New)

A term generally used to describe a system of controls for the automatic operation of track switches whereby routes that are established by a preliminary manual selection are automatically completed by the progress of cars or trains.

Terminal, Carrier. (New)

A group of carrier apparatus at the initiating or terminating end of a carrier system.

Transmitter, Carrier. (New)

An electronic device for generating predetermined carrier frequencies.

Transformer, Impulse. (New)

A transformer whose primary is connected in series with a direct current code line circuit and whose secondary actuates a device, usually a polar relay, in response to changes of the code line current.

Transformer, Matching. (New)

A transformer to match the impedance of the open line wire to the cable (or vice versa) where the line circuit is carrier over both open line wires and cable having different characteristic impedances.

Trimmer Signal. (New)

See definition for Signal, Trimmer.

Unit, Application; Control Office. (New)

A group of relays and circuits in a code system which in conjunction with the control levers forms the control code characters, and which stores the information received from indication codes.

Unit, Auxiliary Line. (New)

See definition for Unit, Code Converter.

Unit, Code Converter. (New)

A group of relays and circuits used in conjunction with field carrier apparatus for conversion and coordination between a carrier circuit and a remotely controlled direct current line.

Unit, Field Application. (New)

A group of relays and circuits in a code system which applies control code information to the proper function control relays and assists in the transmission of indication codes.

Unit, Field Line Coding. (New)

See definition for Unit, Field Stepper.

Unit, Field Stepper. (New)

A group of relays and circuits in a code system that receives and interprets the control codes and generates indication codes from the field to the office.

Unit, Field Storage. (New)

See definition for Unit, Field Application.

Unit, Master; Control Office. (New)

A group of relays and circuits in a code system that generates the control codes and receives and interprets the indication codes.

Unit, Office Line Coding. (New)

See definition for Unit, Master; Control Office.

Unit, Office Storage. (New)

See definition for Unit, Application; Control Office.

Unit, Remote Line. (New)

See definition for Unit, Code Converter.

Unit, Telephone Coupling Capacitor. (New)

A device consisting of high-voltage capacitors, inserted between telephone and line, to prevent faults that may occur in the telephone apparatus and wiring from affecting direct current codes on the line.

Unit, Telephone Coupling Reactor. (New)

A device to prevent faults that may occur in the telephone apparatus and wiring from causing excessive loss to carrier frequencies where telephones are coupled to a code line.

Yard, Classification. (New)

A yard in which cars are classified or grouped in accordance with requirements. (A.R.E.A.)

Yard, Hump. (Revision)

A railroad classification yard in which the classification of cars is accomplished by pushing them over a summit, known as a hump, beyond which they run by gravity.

Action Recommended

Acceptance for submission to letter ballot.

(Revision of A.A.R. Signal Section Specification 112-46)
A.A.R. SIGNAL SECTION SPECIFICATION 112-52.

PORTABLE ALTERNATING CURRENT AMMETER

1. Purpose.

(a) This specification is for the purpose of providing for a portable alternating current ammeter for use on circuits not having d.c. components.

2. Tender.

(a) The tender shall be for a product meeting the requirements of this specification in its entirety.

3. Purchaser's order requirements.

(a) The following additional requirements will be shown on the Purchaser's order:

1. Class of instrument as specified in section 5-b.
2. Range of instrument as specified in section 6-a.
3. Carrying case when required.
4. Inspection and tests as required.

4. Material and workmanship.

(a) Material and workmanship shall be first-class in every respect.

5. Design.

(a) Instrument shall be self-contained of a design acceptable to the Purchaser.

(b) Instruments shall be of two general classes:

1. Those having a 4 in. minimum scale length for use when a relatively high degree of accuracy is desired.
2. Those having a $2\frac{1}{2}$ in. minimum scale length for use when a less accurate reading is acceptable.

6. Ranges and scales.

(a) Ranges and scales shall be as follows:

Single Range

Item	Range	Minimum length of upper arc, in.	Divisions*	No. of blocks*	Divisions per block*
1	0-150 milliamperes	4	150	15	10
2	0-150 milliamperes	$2\frac{1}{2}$	75	$7\frac{1}{2}$	10
3	0-500 milliamperes	4	100	10	10
4	0-500 milliamperes	$2\frac{1}{2}$	50	5	10
5	0-2 amperes	4	100	10	10
6	0-2 amperes	$2\frac{1}{2}$	50	5	10

* Scale divisions and blocks to conform to values specified as far as practicable.

6. *Ranges and scales.*—Continued.

Single Range—Continued

Item	Range	Minimum length of upper arc, in.	Divisions*	No. of blocks*	Divisions per block*
7	0-5 amperes	4	100	10	10
8	0-5 amperes	2½	50	5	10
9	0-15 amperes	4	150	15	10
10	0-15 amperes	2½	75	7½	10
11	0-50 amperes	4	100	10	10
12	0-100 amperes	4	100	10	10

Multi Range

13	0-250 milliamperes	4	125	12½	10
	0-500 milliamperes		100	10	10
14	0-1.5 amperes	4	150	15	10
	0-7.5 amperes				
	0-15 amperes				

* Scale divisions and blocks to conform to values specified as far as practicable.

(b) The figures used for the numbering of scales shall be legible and as large as practicable.

(c) Scales shall not be affected by moisture or changes in temperature.

7. *Binding posts.*

(a) Connections to instrument shall be made on binding posts.

(b) Binding posts shall be mounted so they cannot be turned in the base or frame to which applied. They shall be properly insulated from each other and other metallic parts.

(c) Binding posts need not be marked in single range or multiple range instruments employing a selector switch, but the common post on the multiple range instruments with separate binding posts for each range shall be marked with plus and minus ($\pm$) mark. The other posts on multiple range instruments shall be marked to correspond with the respective ranges.

(d) Binding post nuts shall be so designed that they will not come off in normal use.

(e) Binding post nuts shall be insulated.

8. *Zero corrector.*

(a) An external zero corrector shall be provided on each instrument.

9. *Pointer.*

(a) Pointer shall be the knife-edge type.

10. *Mirror.*

(a) Scale of instruments shall be provided with mirror directly under knife-edge of the pointer.

11. *Moving element.*

(a) The moving element shall turn on hardened accurately ground and highly polished steel or equivalent pivots, bearing on highly polished first-quality sapphires or equivalent jewels. The moving element shall respond quickly to changes in current and shall have a damping factor of not less than three.

12. *Heating.*

(a) Instruments shall not over-heat or show an appreciable error, when left in the circuit indefinitely at full load.

13. *Case.*

(a) Instrument cases shall be constructed with close fitting joints to minimize the entrance of dust and moisture, and shall have a neat and durable finish.

14. *Sealing.*

(a) Instruments shall be sealed to prevent any changes or adjustments except by means of the zero corrector.

15. *Impedance.*

(a) Single and double range instruments.

1. The impedance at from 25 to 100 cycles of instruments with 15 ampere range or less shall be such that full scale deflection will be produced by not more than 3 volt-amperes.

2. The impedance at from 25 to 100 cycles of instruments with 50 ampere range shall be such that full scale deflection will be produced by not more than 5 volt-amperes.

3. The impedance at from 25 to 100 cycles of instruments with 100 ampere range shall be such that full scale deflection will be produced by not more than 7.5 volt-amperes.

(b) Multi range instruments.

1. The impedance at from 25 to 100 cycles shall be such that full scale deflection will be produced by not more than 6 volt-amperes.

16. *Accuracy.*

(a) Instruments having a 4 in. minimum scale shall be accurate within plus or minus 0.75 per cent of full scale deflection at 77 deg. F. at 60 cycles a.c.

(b) Instruments having a 2½ in. minimum scale shall be accurate within plus or minus 1 per cent of full scale deflection at 77 deg. F. at 60 cycles a.c.

(c) This accuracy shall apply only throughout the upper two-thirds of the scale length.

17. Errors due to temperature and frequency.**(a) Temperature error.**

1. Instruments having a 4 in. minimum scale shall not have a temperature error exceeding 0.2 per cent of the indicated value for a change of plus or minus 10 deg. F. Instruments shall be adjusted for 77 deg. F. at 60 cycles a.c.

2. Instruments having a $2\frac{1}{2}$ in. minimum scale shall not have a temperature error exceeding 0.3 per cent of the indicated value for a change of plus or minus 10 deg. F. Instruments shall be adjusted for 77 deg. F. at 60 cycles a.c.

(b) Frequency error.

1. Instruments having a 4 in. minimum scale shall not have a frequency error exceeding 0.5 per cent of the indicated value when used over a range from 25 to 100 cycles. Instruments shall be adjusted for use on 60 cycles a.c.

2. Instruments having a $2\frac{1}{2}$ in. minimum scale shall not have a frequency error exceeding 0.5 per cent of the indicated value when used over a range from 25 to 100 cycles. Instruments shall be adjusted for use on 60 cycles a.c.

18. Data for reference.

(a) Instruments of the non-transformer type shall have the approximate inductance at 60 cycles and the approximate resistance plainly and permanently marked either on the face of the instrument or on a certificate or marking plate permanently attached to the instrument.

(b) Instruments of the transformer type shall have the effective resistance and impedance at 25 and 100 cycles plainly and permanently marked either on the face of the instrument or on a certificate or marking plate permanently attached to the instrument. When the impedance is practically constant from 25 to 100 cycles, only one value need be shown and it shall be marked 25-100 cycles.

19. Name plate.

(a) Name plate showing Manufacturer's name, model and serial numbers shall be attached to each instrument unless this information is shown on dial.

20. Dielectric requirements.

(a) The instrument assembled shall withstand for 1 minute an insulation test, at place of manufacture, of 2,600 volts a.c. between all parts of electric circuits and other metallic parts insulated therefrom.

21. Finish.

(a) Metal parts shall be protected against corrosion except where such protection will interfere with the proper functioning of that part.

21. *Finish.*—Continued.

(b) Material used for protection against corrosion shall neither melt nor flake under atmospheric conditions between temperatures of 40 deg. F. below zero and 185 deg. F. above zero.

22. *Inspection.*

(a) Purchaser may inspect the completed product to determine that the requirements of this specification have been met.

(b) If product has not been accepted at point of production and if, upon arrival at destination, it does not meet the requirements of this specification, it may be rejected, and the Manufacturer, upon request, shall advise the Purchaser what disposition is to be made of the rejected product. Manufacturer shall pay all shipping charges.

(c) If Purchaser is to make inspection at point of production it shall be so stated on Purchaser's order.

23. *Packing.*

(a) Product shall be so assembled or packed as to permit convenient handling and to protect against loss or damage during shipment.

24. *Marking.*

(a) Purchaser's order, requisition and package number, name of Consignor, and name and address of Consignee, shall be plainly marked on outside of package.

25. *Warranty.*

(a) Manufacturer shall warrant the product covered by this specification to be free from defects in material and workmanship under ordinary use and service, his obligation under this warranty being limited to manufacturing, at point of production, any part or parts to replace those which shall be found defective within 1 year after shipment to the Purchaser. This warranty shall not apply to any product which shall have been repaired or altered in any way, by anyone other than the Manufacturer thereof, so as to affect, in the Manufacturer's judgment, its proper functioning or reliability, or which has been subjected to misuse, negligence or accident.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Specification 112-46—Portable Alternating Current Ammeter, Manual Part 3.

(Revision of Instructions for Resistance of Made Grounds)
A.A.R. SIGNAL SECTION INSTRUCTIONS.

MADE GROUNDS*

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These instructions apply to the installation, maintenance and tests of made grounds. They set forth general requirements representing recommended practice.

1. Tests shall be made as instructed to determine the resistance between ground rod and surrounding earth. This resistance should preferably not exceed 15 ohms.

2. If the preferred resistance cannot be obtained by driving a single ground rod, multiple ground rods, or sectional ground rods, the soil should be treated by digging a circular trench 15 inches wide, 18 inches deep, and 48 inches in outside diameter around each rod; distribute 50 to 75 pounds of rock salt, depending upon soil resistivity, in trench; flood trench with water two or three times and then replace the soil in trench.

3. Where arrester location is on top of fill and desired resistance of ground is not obtained at the arrester location, supplementary ground rod or rods may be driven at the foot of the slope where good soil exists, or ground rods may be driven under the track at an angle of about 45 degrees, observing maintenance-of-way requirements. In such cases the ground rod at the arrester location must be maintained.

4. An approved instrument meeting the requirements of Specification 257, Manual Part 103, or equivalent, should be used. Manufacturer's instructions for using the instrument must be followed.

5. Wire connection between the single or multiple ground rods and the lightning arresters shall consist of a soft-drawn copper wire, size not smaller than No. 6 A.W.G., which shall be run as directly as practicable, avoiding acute angles, and must have sufficient slack to avoid breakage from the effects of frost.

6. Air space of not less than $\frac{3}{8}$ inch, or equivalent insulation, shall be maintained between wire connection and operating circuits.

7. Wire connection to ground shall conform to Drawing 1424.

8. Ground rod shall be located as close as practicable to lightning arresters, but not less than 3 feet from post, pole or foundation. Where space is not available to drive ground rod vertically, the rod may be at an angle so that the lower end is more than 3 feet from post, pole or foundation.

9. Ground rod shall be driven into the ground at least 8 feet wherever practicable.

* The term "as instructed" as used herein refers to individual railroad instructions.

10. Where multiple ground rods are used, they shall be placed at least 6 feet apart.

11. Results of inspections and tests herein required and all other inspections and tests that may be required must be recorded as instructed.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Instructions for Resistance of Made Grounds, Manual Part 61.

(Revision of A.A.R. Signal Section Specification 85-46)
A.A.R. SIGNAL SECTION SPECIFICATION 85-52.

PORTABLE DIRECT CURRENT VOLTMETERS,
AMMETERS AND VOLT-AMMETERS

1. *Purpose.*

(a) This specification is for the purpose of providing for portable direct current voltmeters, ammeters and volt-ammeters.

2. *Tender.*

(a) The tender shall be for a product meeting the requirements of this specification in its entirety.

3. *Purchaser's order requirements.*

(a) The following additional requirements will be shown on the Purchaser's order:

1. Type of instrument.
2. Class of instrument as specified in section 6-b.
3. Range combinations as specified in section 7-a.
4. Push button, fuses and selector switch when required.
5. Carrying case when required.
6. Inspection and tests as required.
7. Alternate requisites as required.

4. *Alternates.*

(a) The provisions contained in the alternate requisites section of this specification form a part hereof only when substituted by Purchaser's order for the provisions contained in this specification.

5. *Material and workmanship.*

(a) Material and workmanship shall be first-class in every respect.

6. *Design.*

(a) Instruments shall be self-contained of a design acceptable to the Purchaser.

(b) Instruments shall be of two general classes:

1. Those having a 4 in. minimum scale length for use when a relatively high degree of accuracy is desired.
2. Those having a $2\frac{1}{2}$ in. minimum scale length for use when a less accurate reading is acceptable.

7. *Ranges.*

(a) Ranges shall be as follows (†R-7-a):

1. Voltmeter shall be made with five ranges: 150—75—30—3—1.5.
2. Ammeter shall be made with six ranges: 30—15—3—1.5—0.15—0.030.
3. Volt-ammeter shall be made with one of the following four range combinations, as specified by the Purchaser:

Voltage ranges	Ampere ranges
30—3—1.5	3—0.3—0.03
30—3—1.5	30—3—0.3
150—30—3	15—1.5—0.15
150—15—3	15—1.5—0.15

8. *Scales.*

(a) Scales shall not be affected by moisture or changes in temperature.

(b) Length and division of scales shall be as follows:

Minimum length of scale, in.	Divisions	No. of blocks	Divisions per block
4	120 to 150	12 to 15	10
2½	75 or 60*	5 or 6*	15 or 10*

* Depending on combination of ranges selected.

(c) Scale length shall be measured along the upper arc.

(d) The figures used for the numbering of scales shall be legible and as large as practicable.

(e) A block may consist of 10 or 15 divisions and each block of the scale for voltmeters, ammeters, and volt-ammeters shall be clearly marked to show the reading values at these points, corresponding with the ranges contained in the instrument. On all scales having 15 divisions per block, the main block shall consist of three smaller blocks of 5 divisions with the cardinal lines of equal length.

9. *Binding posts.*

(a) Connections to instrument shall be made on binding posts.

(b) Binding posts shall be mounted so they cannot be turned in the base or frame to which applied. They shall be properly insulated from each other and other metallic parts.

(c) Binding posts shall be plainly marked:

1. Positive post with a plus (+) mark.

2. Other posts with respective ranges except on volt-ammeters with a range selector switch on which the other ammeter post is marked "Amps.," and the other voltmeter post is marked "Volts."

† Alternate requisites section.

9. *Binding posts.*—Continued.

- (d) Binding post nuts shall be so designed that they will not come off in normal use.
- (e) Binding post nuts shall be insulated.

10. *Range selecting switch.*

- (a) Where range selecting switch is used, the switch positions shall be plainly and permanently marked to correspond with the ranges as connected.
- (b) The "off" position of the switch shall be suitably marked and shall be located midway between the voltage and ampere ranges.
- (c) Ranges shall be so connected to the switch that the ampere ranges will be grouped on one side and the voltage ranges on the opposite side and both groups graduated from highest to lowest ranges with the highest range adjacent to the "off" position of the switch.

11. *Fuses.*

- (a) Where fuses are provided:
 - 1. They shall be clearly and permanently marked for the purpose intended.
 - 2. Means shall be provided in each instrument for carrying at least two spare renewal fuses for each purpose intended.
 - 3. They shall be accurately calibrated so that they will not appreciably affect the accuracy of the ranges in which they are to be used.
 - 4. They shall be so located as to permit ready access for changing fuses without disturbing the seal.
 - 5. Fuse clips shall be clearly and permanently labeled to correspond with the purpose intended.

12. *Zero corrector.*

- (a) An external zero corrector shall be provided on each instrument.

13. *Pointer.*

- (a) Pointer shall be the knife-edge type.

14. *Mirror.*

- (a) Scale of instruments shall be provided with mirror directly under knife-edge of the pointer.

15. *Moving element.*

- (a) The moving element shall turn on hardened accurately ground and highly polished steel or equivalent pivots, bearing on highly polished first-quality sapphires or equivalent jewels. The moving element shall respond quickly to changes in current and shall have a damping factor of not less than three.

16. *Shielding.*

(a) Instruments shall be shielded from magnetic influences caused, for example, by setting the instrument on a steel plate or surface.

17. *Push button.*

(a) Where a push button is provided in the voltage circuit it shall be so arranged that it can be locked in the depressed position.

18. *Heating.*

(a) Instruments shall not over-heat or show an appreciable error, when left in the circuit indefinitely at full load.

19. *Case.*

(a) Instrument case shall be constructed with close fitting joints to minimize the entrance of dust and moisture and shall have a neat and durable finish.

20. *Sealing.*

(a) Instruments shall be sealed to prevent any changes or adjustments except by means of the zero corrector.

21. *Current loss.*

(a) Current losses for voltage ranges shall be as follows:

1. Instruments having a minimum scale length of 4 in., not less than 1,000 ohms per volt for voltmeters, and 100 ohms per volt for volt-ammeters.

2. Instruments having a minimum scale length of $2\frac{1}{2}$ in., not less than 100 ohms per volt.

22. *Accuracy.*

(a) Instruments having a 4 in. minimum scale shall be accurate within plus or minus 0.5 per cent of full scale deflection at 77 deg. F.

(b) Instruments having a $2\frac{1}{2}$ in. minimum scale shall be accurate within plus or minus 1 per cent of full scale deflection at 77 deg. F.

23. *Error due to temperature.*

(a) Instruments having a 4 in. minimum scale shall not have a temperature error exceeding 0.5 per cent of the indicated value for a change of plus or minus 10 deg. F. Instruments shall be adjusted for 77 deg. F.

(b) Instruments having a $2\frac{1}{2}$ in. minimum scale shall not have a temperature error exceeding 1 per cent of the indicated value for a change of plus or minus 10 deg. F. Instruments shall be adjusted for 77 deg. F.

24. *Data for reference.*

(a) Instruments shall have the resistance of voltmeter ranges plainly and permanently marked either on the face of the instrument or on a certificate or marking plate permanently attached to the instrument. The resistance may be expressed, as, for example, "100 ohms per volt."

25. *Name plate.*

(a) Name plate showing Manufacturer's name, model and serial numbers shall be attached to each instrument unless this information is shown on dial.

26. *Dielectric requirements.*

(a) Instrument assembled shall withstand for 1 minute an insulation test, at place of manufacture, of 2,600 volts a.c. between all parts of electric circuits and other metallic parts insulated therefrom.

27. *Finish.*

(a) Metal parts shall be protected against corrosion except where such protection will interfere with the proper functioning of that part.

(b) Material used for protection against corrosion shall neither melt nor flake under atmospheric conditions between temperatures of 40 deg. F. below zero and 185 deg. F. above zero.

28. *Inspection.*

(a) Purchaser may inspect the completed product to determine that the requirements of this specification have been met.

(b) If product has not been accepted at point of production and if, upon arrival at destination, it does not meet the requirements of this specification, it may be rejected, and the Manufacturer, upon request, shall advise the Purchaser what disposition is to be made of the rejected product. Manufacturer shall pay all shipping charges.

(c) If Purchaser is to make inspection at point of production it shall be so stated on Purchaser's order.

29. *Packing.*

(a) Product shall be so assembled or packed as to permit convenient handling and to protect against loss or damage during shipment.

30. *Marking.*

(a) Purchaser's order, requisition and package number, name of Consignor, and name and address of Consignee, shall be plainly marked on outside of package.

31. *Warranty.*

(a) Manufacturer shall warrant the product covered by this specification to be free from defects in material and workmanship under ordinary use and service, his obligation under this warranty being limited to manufacturing, at point of production, any part or parts to replace those which shall be found defective within 1 year after shipment to the Purchaser. This warranty shall not apply to any product which shall have been repaired or altered in any way by anyone other than the Manufacturer thereof, so as to affect, in the Manufacturer's judgment, its proper functioning or reliability or which has been subjected to misuse, negligence or accident.

Alternate requisites.

R-7-a.

Ranges shall be as follows:

Voltage ranges	Ampere ranges
1.5	0.03
3	0.15
15	0.3
30	1.5
150	3
300	15
	30

1. Voltmeter shall be made with ranges, not exceeding six, as specified by the Purchaser.

2. Ammeter shall be made with ranges, not exceeding six, as specified by the Purchaser.

3. Volt-ammeter shall be made with voltage ranges and ampere ranges, not exceeding six, as specified by the Purchaser. (Combinations for volt-ammeters are usually made up of three of the voltage ranges in combination with three of the ampere ranges.)

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Specification 85-46—Portable Direct Current Voltmeters, Ammeters and Volt-Ammeters, Manual Part 168.

(Revision of A.A.R. Signal Section Specification 115-46)
A.A.R. SIGNAL SECTION SPECIFICATION 115-52.

PORTABLE ALTERNATING CURRENT VOLTMETER

1. Purpose.

(a) This specification is for the purpose of providing for a portable alternating current voltmeter.

2. Tender.

(a) The tender shall be for a product meeting the requirements of this specification in its entirety.

3. Purchaser's order requirements.

(a) The following additional requirements will be shown on Purchaser's order:

1. Class of instrument as specified in section 5-b.
2. Range of instrument as specified in section 6-a.
3. Fuses and selector switch when required.
4. Carrying case when required.
5. Inspection and tests as required.

4. Material and workmanship.

(a) Material and workmanship shall be first-class in every respect.

5. Design.

(a) Instrument shall be self-contained of a design acceptable to the Purchaser.

(b) Instruments shall be of two general classes:

1. Those having a 4 in. minimum scale length for use when a relatively high degree of accuracy is desired.
2. Those having a $2\frac{1}{2}$ in. minimum scale length for use when a less accurate reading is acceptable.

6. Ranges and scales.

(a) Ranges and scales shall be as follows:

Item No.	Volts	Minimum length of upper arc, in.	Divisions*	No. of blocks*	Divisions per block*
1	0-75	4	150	15	10
	0-150				
	0-300				

* Scale divisions and blocks to conform to values specified as far as practicable.

6. *Ranges and scales.*—Continued.

Item No.	Volts	Minimum length of upper arc, in.	Divisions*	No. of blocks*	Divisions per block*
2	0-75 0-150 0-300	2½	75	7½	10
3	0-1 0-5 0-25 0-125	4	100 125	10 12½	10 10
4	0-1 0-5 0-25 0-125	2½	50	5	10

* Scale divisions and blocks to conform to values specified as far as practicable.

(b) The figures used for the numbering of scales shall be legible and as large as practicable.

(c) Scales shall not be affected by moisture or changes in temperature.

7. *Binding posts.*

(a) Connections to instrument shall be made on binding posts.

(b) Binding posts shall be mounted so they cannot be turned in the base or frame to which applied. They shall be properly insulated from each other and other metallic parts.

(c) Binding posts need not be marked in single range or multiple range instruments employing a selector switch, but the common post on the multiple range instruments with separate binding posts for each range shall be marked with plus and minus ($\pm$) mark. The other posts on multiple range instruments shall be marked to correspond with the respective ranges.

(d) Binding post nuts shall be so designed that they will not come off in normal use.

(e) Binding posts shall be insulated.

8. *Range selecting switch.*

(a) Where a range selecting switch is used, the switch positions shall be plainly and permanently marked to indicate the range in use.

9. *Fuses.*

(a) Where fuses are provided:

1. They shall be clearly and permanently marked for the purpose intended.

2. They shall be accurately calibrated so that they will not appreciably affect the accuracy of the ranges in which they are to be used.

10. *Zero corrector.*

(a) An external zero corrector shall be provided on each instrument.

11. *Pointer.*

(a) Pointer shall be the knife-edge type.

12. *Mirror.*

(a) Scale of instruments shall be provided with mirror directly under knife-edge of the pointer.

13. *Moving element.*

(a) The moving element shall turn on hardened accurately ground and highly polished steel or equivalent pivots, bearing on highly polished first-quality sapphires or equivalent jewels. The moving element shall respond quickly to changes in current and shall have a damping factor of not less than three.

14. *Heating.*

(a) Instruments shall not over-heat or show an appreciable error, when left in the circuit indefinitely at full load.

15. *Case.*

(a) Instrument case shall be constructed with close fitting joints to minimize the entrance of dust and moisture and shall have a neat and durable finish.

16. *Sealing.*

(a) Instrument shall be sealed to prevent any changes or adjustments except by means of the zero corrector.

17. *Current loss.*

(a) Current losses for various combinations, section 6-a, shall be as follows:

1. Not less than 15 ohms per volt, for Item No. 1.
2. Not less than 30 ohms per volt, for Item No. 2.
3. Not less than 100 ohms per volt, for Item No. 3.
4. Not less than 20 ohms per volt, for Item No. 4.

18. *Accuracy.*

(a) Instruments having a 4 in. minimum scale shall be accurate within plus or minus 0.75 per cent of full scale deflection at 77 deg. F. at 60 cycles a.c.

(b) Instruments having a $2\frac{1}{2}$ in. minimum scale shall be accurate within plus or minus 1 per cent of full scale deflection at 77 deg. F. at 60 cycles a.c.

(c) This accuracy shall apply only throughout the upper two-thirds of the scale length.

19. *Errors due to temperature and frequency.*

(a) Temperature error.

1. Instruments having a 4 in. minimum scale shall not have a temperature error exceeding 0.3 per cent of the indicated value for a change of plus or minus 10 deg. F. Instruments shall be adjusted for 77 deg. F. at 60 cycles a.c.

2. Instruments having a $2\frac{1}{2}$ in. minimum scale shall not have a temperature error exceeding 0.8 per cent of the indicated value for a change of plus or minus 10 deg. F. Instruments shall be adjusted for 77 deg. F. at 60 cycles a.c.

(b) Frequency error.

1. Instruments having a 4 in. minimum scale shall not have a frequency error exceeding 0.75 per cent of the indicated value when used over a range from 25 to 100 cycles. Instruments shall be adjusted for use on 60 cycles a.c.

2. Instruments having a $2\frac{1}{2}$ in. minimum scale shall not have a frequency error exceeding 0.75 per cent of the indicated value for instruments per Item No. 2, section 6-a, and not exceeding 3 per cent of the indicated value for instruments per Item No. 4, section 6-a, when used over a range from 25 to 100 cycles. Instruments shall be adjusted for use on 60 cycles a.c.

20. *Data for reference.*

(a) Instruments shall have the resistance of ranges plainly and permanently marked either on the face of the instrument or on a certificate or marking plate permanently attached to the instrument.

21. *Name plate.*

(a) Name plate showing Manufacturer's name, model and serial numbers shall be attached to each instrument unless this information is shown on dial.

22. *Dielectric requirements.*

(a) The instrument assembled shall withstand for 1 minute an insulation test, at place of manufacture, of 2,600 volts a.c. between all parts of electric circuits and other metallic parts insulated therefrom.

23. *Finish.*

(a) Metal parts shall be protected against corrosion except where such protection will interfere with the proper functioning of that part.

(b) Material used for protection against corrosion shall neither melt nor flake under atmospheric conditions between temperatures of 40 deg. F. below zero and 185 deg. F. above zero.

24. Inspection.

(a) Purchaser may inspect the completed product to determine that the requirements of this specification have been met.

(b) If product has not been accepted at point of production and if, upon arrival at destination, it does not meet the requirements of this specification, it may be rejected, and the Manufacturer, upon request, shall advise the Purchaser what disposition is to be made of the rejected product. Manufacturer shall pay all shipping charges.

(c) If Purchaser is to make inspection at point of production it shall be so stated on Purchaser's order.

25. Packing.

(a) Product shall be so assembled or packed as to permit convenient handling and to protect against loss or damage during shipment.

26. Marking.

(a) Purchaser's order, requisition and package number, name of Consignor, and name and address of Consignee, shall be plainly marked on outside of package.

27. Warranty.

(a) Manufacturer shall warrant the product covered by this specification to be free from defects in material and workmanship under ordinary use and service, his obligation under this warranty being limited to manufacturing, at point of production, any part or parts to replace those which shall be found defective within 1 year after shipment to the Purchaser. This warranty shall not apply to any product which shall have been repaired or altered in any way by anyone other than the Manufacturer thereof, so as to affect, in the Manufacturer's judgment, its proper functioning or reliability, or which has been subjected to misuse, negligence or accident.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Specification 115-46—Portable Alternating Current Voltmeter,
Manual Part 169.

A.A.R. SIGNAL SECTION INSTRUCTIONS.

ELECTRIC SWITCH LOCKS*

1952

These instructions apply to the installation, maintenance and test of electric locks applied to hand-operated switches. They set forth general requirements representing recommended practice.

1. Maintenance, tests and repair work which may interfere with safe operation of trains must not be started until train movements have been fully protected. Temporary repairs or adjustments, when required, must be made in such manner that safety of train operation will not be impaired. When repair, adjustment, change or replacement is made, tests must be made immediately to determine that the apparatus functions as intended. When making tests of apparatus, proper instruments must be used and it must be known that no unsafe conditions are set up by the application of testing equipment.
2. When electric lock is to be changed, temporarily removed, or becomes defective, proper measures must be taken as instructed to protect train movements, until electric lock is restored to normal operation.
3. Electric locks must be installed and maintained as instructed so as to conform to established clearances for equipment.
4. Electric locks must be securely fastened in place.
5. Magnetic air gap must not be changed in the field.
6. Contacts must be kept clean and in proper adjustment as instructed. Contact openings must be not less than 0.050 inch when open.
7. Movable parts must be kept clean, properly adjusted and lubricated as instructed.
8. Parts which fail to perform their intended functions must be promptly adjusted, repaired or replaced.
9. Bolts, nuts, pins and cotters of proper size and type must be kept in place, nuts kept tight and cotters properly spread.
10. Covers and fastenings must be kept in good condition with suitable gaskets in place.
11. All padlocks or seals must be maintained as instructed.
12. Ventilator screens must be in place and kept free of paint or other obstruction.
13. Wire and cable entrances must be properly sealed to prevent entrance of moisture, rodents and insects.
14. Threads of rods, jaws and bolts must be kept clean and properly lubricated.
15. Paint must be applied as often as required. Rusty surfaces must be cleaned before painting. Paint must not be applied to padlocks, threads of screw jaws, adjusting screws, or gaskets.

* The term "as instructed" as used herein refers to individual railroad instructions.

16. Edges of locking dogs or notches must be examined frequently and any having rounded or otherwise distorted locking surfaces must be replaced.

17. Locking plungers or dogs must not be lubricated.

18. Tests must be made as instructed to determine that:

(a) Signals governing movements over switch are displaying proper restrictive indications, when electric lock is unlocked or when switch is not in proper position.

(b) Movement of train over switch will not cause contacts to open or close improperly.

(c) Operation of emergency means for unlocking, where provided, will cause signals to display the proper restrictive indications.

(d) Any preliminary movement of the electric lock mechanism, before securing an electrical unlock, must not be enough to permit switch operation.

(e) Electric lock unlocks to permit train or engine to enter main track by either of the following:

1. Without a time interval when approach control track circuits are unoccupied.

2. After signal control circuits have been opened and after the expiration of a time interval, determined in accordance with Instructions for Time Releases Applied to Signal Apparatus, Manual Part 128.

(f) Electric lock unlocks to permit train or engine to leave main track by either of the following:

1. Without a time interval by de-energization of track relay for short track circuit where used.

2. After expiration of a predetermined time interval when initiated manually at the switch or initiated by de-energization of track relay for track circuit or circuits immediately in advance of the switch.

19. Pick-up and drop-away tests must be made periodically as instructed.

20. Electric locks removed from service for repairs must be returned with full information as required on repair tag Form 7018, Manual Part 124, as instructed.

21. Results of inspection and tests herein required and all other inspections and tests that may be required must be recorded as instructed.

Action Recommended

Acceptance for submission to letter ballot.

**SIMPLIFIED SYSTEM OF NUMBERING AND IDENTIFICATION
OF WIRES AND CIRCUITS WHICH DOES NOT REQUIRE THE
CHANGING OF NOMENCLATURE AND TAGS ON WAYSIDE
CIRCUITS WHEN A MINOR CHANGE IS MADE**

In connection with this assignment, a questionnaire, Inquiry SS-91A, was issued to Voting Representatives of Member Roads in the Signal Section. Seventy-six replies were received, indicating that a majority are using the system outlined in Manual Part 33, which requires the changing of nomenclature and tags on wayside circuits when a minor change is made. They do, however, in many instances, make minor modifications to the system outlined in Manual Part 33, principally to accommodate the system to local conditions and individual railroad practice. Some of these modifications are:

1. Break numbers $1/4-1/2-3/4$.
2. By use of decimal numbers.
3. By use of alphabetical suffix.
4. By eliminating break numbers.

The majority indicated that they know of no simplified system which will avoid the changing of the nomenclature and tags throughout the wayside circuit when a minor change is made.

Action Recommended

Acceptance as information.

(Revision and Consolidation of Instructions for Non-Coded Direct Current Track Circuits, Instructions for Non-Coded Alternating Current Track Circuits, and Instructions for Coded Direct Current Track Circuits)
A.A.R. SIGNAL SECTION INSTRUCTIONS.

TRACK CIRCUITS*

1952

These instructions apply to the installation, maintenance and test of track circuits. They set forth general requirements representing recommended practice.

General.

1. Maintenance, tests and repair work which may interfere with safe operation of trains must not be started until train movements have been fully protected. Temporary repairs or adjustments, when required, must be made in such manner that safety of train operation will not be impaired. When repair, adjustment, change or replacement is made, tests must be made immediately to determine that the apparatus functions as intended. When making tests of apparatus, proper instruments must be used and it must be known that no unsafe conditions are set up by the application of testing equipment.

2. The length of any track circuit, except trap circuit or special circuit not used for control of signaling facilities, must be maintained greater than maximum inner wheel base of any engine or car.

3. Where shortest outer wheel base of an engine or car operating over any dead section is less than 35 feet, the maximum length of the dead section must be so maintained that it will not exceed the length of the outer wheel base of such engine or car unless special circuit is used.

4. Bonding must be installed and maintained in condition to insure low resistance. Bolts in angle bars should be kept tight.

5. Bonding must be inspected as instructed and renewed as required.

6. Each wire must be tagged or otherwise marked so it can be identified at each terminal. Nomenclature must correspond to that of the circuit plan. Tags or other marks of identification in instrument cases and apparatus housings must be made of insulating material. Wires, tags, or other markings must not interfere with moving parts of apparatus.

7. Parts which fail to perform their intended functions must be promptly adjusted, repaired or replaced.

8. When track or other conditions are such that they may cause signal interruption or unsatisfactory operation of signal apparatus, the section foreman, or whoever is immediately responsible for such conditions, must be requested to remedy the condition. If such request is not acted upon within a reasonable time, the matter must be reported to proper authority in writing.

* The term "as instructed" as used herein refers to individual railroad instructions.

General.—Continued.

9. Shunt wires and fouling wires, except shunt wires to switch circuit controller through which signal control circuits are controlled and track circuits are shunted, must consist of at least two conductors and each must be of sufficient conductivity and maintained in such condition that the track relay will be in de-energized position when the circuit is shunted.

10. Fouling section of turnout must be so maintained that it will extend to clearance point or as instructed.

11. Track relay must be in de-energized position whenever any of the following conditions exist, and the track circuit of an automatic train stop, train control, or cab signal system must be de-energized in the rear of the point where any of the following conditions exist:

(a) When a rail is broken or a rail or switch frog is removed except when a rail is broken or removed in the shunt fouling circuit of a turnout or crossover, provided, however, that shunt fouling circuit may not be used in a turnout through which permissible speed is greater than 45 miles per hour.

(b) When a train, engine, or car occupies any part of a track circuit, including fouling section of turnout, except turnouts of a hand-operated main track crossover.

(c) Where switch shunting circuit is used:

1. Switch point is not closed in normal position.

2. A switch is not locked where facing point lock with circuit controller is used.

3. An independently operated fouling point derail equipped with switch circuit controller is not in derailing position.

12. Where practicable, top of rails should be kept free from sand, rust, dirt, or other foreign matter that prevents effective shunting of track circuit.

13. Track circuit connectors and connections must be maintained in good condition.

14. Pipe lines under rail must clear base of rail at least $\frac{1}{2}$ inch.

15. Lightning arresters and made grounds must be properly connected, maintained and tested as instructed.

16. Ballast resistance should be kept as high as possible by keeping ballast free from rail and rail fastenings and providing proper drainage. Broken track spikes must not be driven through ties.

17. Resistance of ballast should preferably be not less than 2 ohms per 1,000 feet of track.

18. When making train shunt resistance test it should be made in accordance with Form 7003, Manual Part 196.

19. Shunting sensitivity test of a track circuit must be made by determining the maximum resistance that can be placed across the rails opposite the relay and opposite the source of energy to cause the relay to assume its de-energized position.

(a) Where track circuits include turnouts or crossovers, additional shunting sensitivity tests must be made at the following locations:

1. Turnouts.

(a) Switch point side of insulated joints in lead rails and at each end of fouling circuit.

General.—Continued.

2. Crossovers.

(a) Switch point side of insulated joints in lead rails and both sides of insulated joints at center of crossover.

(b) Where center insulated joints are not used, make tests at locations specified in Instruction 19-a-1.

(b) If the shunt resistance is less than 0.06 ohm, corrective measures must be taken at once.

20. Shunting tests must be made during dry weather conditions when the maximum current is flowing through the relay coils.

21. Switch circuit controllers must be maintained and tested in accordance with Instructions for Switch Circuit Controllers, Manual Part 134.

22. Insulated rail joints must be maintained and tested in accordance with Instructions for Insulated Rail Joints, Manual Part 133.

23. Wire and cable must be maintained and handled in accordance with Instructions for Wire and Cable, Manual Part 190.

24. Ground resistance must be maintained and tests made in accordance with Instructions for Made Grounds, Manual Part 61.

25. Unauthorized experiments or alterations in track circuits must not be made.

26. Any unusual occurrences or developments in track circuits must be promptly reported to proper authority.

27. Results of inspections and tests herein required and all other inspections and tests that may be required must be recorded as instructed.

Non-coded direct current track circuits.

28. Track circuits must be so adjusted that proper working current will flow through the coils of relay during minimum ballast resistance conditions, and checks made to determine that under these conditions, or under maximum ballast resistance conditions, the current through the coils of track relay will not exceed 30 milliamperes for 2-ohm relays or 20 milliamperes for 4-ohm relays, having iron magnetic structure, and will not exceed 40 milliamperes for 2-ohm relays or 27 milliamperes for 4-ohm relays, having silicon steel magnetic structure, with train shunt applied as specified in Tables I, II, III and IV of Formulae for Computing Minimum Allowable Resistance between Track Battery and Track and for Computing Related Current and Voltage Data, Manual Part 132.

29. Where relayed cut-section is used in territory where non-coded direct current track circuits are in use, the energy circuit to the adjoining track circuit must be open and the track circuit shunted when the track relay at such cut-section is in de-energized position.

30. At grade crossing with an electric railroad where foreign current is present, the electric energy for non-coded direct current track circuit must feed away from the crossing. To minimize the effect of foreign current on direct current track circuits, follow Manual Part 127.

31. For track circuits having 2-ohm or 4-ohm relays, resistance between battery and rails must be not less than that shown in Tables I, II, III and IV of Formulae for Computing Minimum Allowable Resistance between Track

Non-coded direct current track circuits.—Continued.

Battery and Track and for Computing Related Current and Voltage Data, Manual Part 132.

32. For track circuits having relays other than 2-ohm or 4-ohm resistance, minimum limiting resistance allowable in series with track battery must be maintained as instructed.

33. Direct current track circuit tests must be made in accordance with Forms 7021 and 7022, Manual Part 131.

34. Relays must be maintained and tested in accordance with Instructions for Direct Current Relays, Manual Part 126.

35. Cells and batteries must be maintained and tested in accordance with Instructions for Cells and Batteries, Manual Parts 7 and 14.

36. Rectifiers and motor-generators must be maintained and tested in accordance with Instructions for Rectifiers and Motor-Generators, Manual Part 68.

Coded direct current track circuits.

37. Track circuits must be so adjusted that proper working current will flow through the coils of relay during minimum ballast resistance conditions.

38. With an 0.06 ohm train shunt applied at the battery end of the track circuit, tests must be made during maximum ballast resistance conditions, as well as during minimum ballast resistance conditions to determine that the current through the coils of relay is less than the minimum pick-up value or field requirement as established by the instructions for the particular relay installed. These tests must be made under conditions of maximum voltage characteristic for the type of battery in service.

39. Direct current track circuit tests must be made in accordance with Forms 7021 and 7022, Manual Part 131.

40. Relays must be maintained and tested in accordance with Instructions for Direct Current Relays, Manual Part 126.

41. Cells and batteries must be maintained and tested in accordance with Instructions for Cells and Batteries, Manual Parts 7 and 14.

42. Rectifiers and motor-generators must be maintained and tested in accordance with Instructions for Rectifiers and Motor-Generators, Manual Part 68.

43. Resistance between battery and rails must be not less than that established as the minimum for each type of relay installed as instructed.

Non-coded alternating current track circuits.

44. The adjustment of alternating current track circuits depends on many factors, such as the type of track circuit; whether double or single rail with steam or electric traction; the length of the track circuit; the ballast condition; the desired shunting values at both relay and transformer ends of the track circuit; the type of relay; and the weight of train equipment.

45. Voltage at the relay local terminals must be as near as possible the normal voltage given on the manufacturer's tag or name plate. If less than the normal voltage value is impressed across the local terminals, more energy will have to be used in the track element to cause proper operation, except for centrifugal frequency relays. While a reduction in the local voltage of a

Non-coded alternating current track circuits.—Continued.

centrifugal frequency relay generally does not require additional energy to the track element, this reduction in the local voltage should be avoided as it tends to increase the time of shunting.

46. For single-element relays, the voltage at the relay track terminals under wet ballast or other adverse conditions must be at least 10 per cent higher than the values given on the manufacturer's tag or name plate to take care of varying ballast conditions and bonding. For two-element relays, the voltage on the relay track terminals under wet ballast or other adverse conditions must be 10 per cent higher than that necessary to energize the relay with normal front contact compression. On account of varying phase angle conditions the necessary voltage on the track element may be considerably in excess of the values marked on the manufacturer's tag or name plate. A check for the proper voltage to be applied across the track terminals of a relay under wet or other unfavorable conditions, is to shunt the relay so that its contacts open halfway, then remove the shunt, and if the contacts come up to the front stop, sufficient energy is passing through the track windings.

47. When shunting two-element track relays, shunt must be applied at the terminals of the track element and not the local element.

48. On steam road track circuits the voltage on the rails at transformer end should be not more than one-half that at the transformer secondary under the worst track conditions. Where reactive transformers are in use, the voltage on the rails at transformer end should be not more than one-half the open circuit transformer secondary voltage.

49. To obtain adequate broken-rail protection on electric road track circuits, it may be necessary to make adjustments so that under worst track conditions the voltage at the rails opposite the transformer is two-thirds that of the transformer secondary. Where reactive transformers are in use the voltage on the rails at transformer end should be not more than two-thirds the open circuit transformer secondary voltage.

50. To obtain the best operation of two-element track relays under adverse ballast conditions, phase measuring instruments should be used to determine that the phase angle relations in the relay approach the ideal value. These measurements may indicate that adjustments should be made to improve phase relations.

51. Alternating current track circuit tests must be made in accordance with A.C. Track Circuit Characteristics, Manual Part 161.

52. Relays must be maintained and tested in accordance with Instructions for Alternating Current Relays, Manual Part 124.

53. Where two-element track relays are used, polarities of adjacent track circuits must be staggered when the signals are in the clear position.

54. To obtain broken-rail detection on electric road track circuit, it is desirable that cross-bonds between neutral connections of impedance bonds on parallel tracks or between a neutral connection and a negative propulsion return cable should not be located closer than at alternate impedance bond locations. Calculations should be made and checked by field tests under the most adverse conditions so that the cross-bonding as installed does not interfere with the desired broken-rail detection.

55. Both rails of a double-rail electric road track circuit should be equally well bonded because defective bonding in one rail will cause an unbalanced

Non-coded alternating current track circuits.—Continued.

condition of the track circuit due to unequal amounts of return propulsion current in the two rails.

(a) With direct current propulsion and double-rail track circuits, unbalanced propulsion current may saturate the iron core of the impedance bonds. This may lower the bond impedance to such a point that the track relay may be shunted.

(b) With alternating current propulsion and double-rail track circuits, unbalanced propulsion current will cause the impedance bond to act as an auto-transformer. Since the track relay is connected in multiple with the bond the auto-transformer voltage may cause sufficient alternating current of propulsion frequency to flow in the relay to cause it to open its contacts, or to blow the protective fuse.

56. Where single-rail track circuits are used on electric roads, care must be taken to adjust the resistors at the relay and transformer ends so that the amount of propulsion current permitted to flow through the relay track winding is less than the allowable amount specified for a given relay. Where heavy direct current propulsion is present, a shielding or a balancing impedance may also be installed in connection with the track relay to protect against direct current in the relay windings.

57. The current limiting device used in the transformer track lead should be a reactor if possible, as the losses in a reactor are less than in a resistor. A resistor in place of a reactor should be used only when required to give correct phase relations in two-element track relays or to protect the relay and transformer from propulsion return current.

58. Fuses must be inspected as instructed and replaced in kind when necessary.

59. To measure the current the relay is receiving from the track circuit, measure first the voltage across the relay track terminals, then insert an ammeter in the track leads and again measure the terminal voltage. This voltage divided by the current gives the impedance of the relay which corresponds to the resistance of a direct current relay. Divide the relay terminal voltage, read with the ammeter removed, by the impedance. The result obtained will be the relay current.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Instructions for Non-Coded Direct Current Track Circuits, Manual Part 8.

Instructions for Non-Coded Alternating Current Track Circuits,
Manual Part 162.

Instructions for Coded Direct Current Track Circuits, Manual Part 218.

(Revision of Instructions for Copper-Oxide Caustic Soda Primary Cells)
A.A.R. SIGNAL SECTION INSTRUCTIONS.

COPPER-OXIDE CAUSTIC SODA PRIMARY CELLS*

1952

These instructions apply to the installation, maintenance and test of copper-oxide caustic soda primary cells. They set forth general requirements representing recommended practice.

1. Maintenance, tests and repair work which may interfere with safe operation of trains must not be started until train movements have been fully protected. Temporary repairs or adjustments, when required, must be made in such manner that safety of train operation will not be impaired. When repair, adjustment, change or replacement is made, tests must be made immediately to determine that the apparatus functions as intended. When making tests of apparatus, proper instruments must be used and it must be known that no unsafe conditions are set up by the application of testing equipment.

2. Parts which fail to perform their intended functions must be promptly adjusted, repaired or replaced.

3. Instructions issued by manufacturers must be followed unless they conflict with general or detailed instructions in which case proper authority must be consulted.

4. Cells must be protected against rain, snow, extreme heat or cold, and should be kept clean.

5. Where freezing temperatures prevail, outside housings should be installed and maintained as instructed.

6. Housings should be located so as to prevent flooding.

7. Cells must set level on floors, shelves or racks. Where required, provision must be made to keep cells from shifting.

8. The performance should be recorded on Form 7007 as instructed.

9. Material for one complete cell (except water) must consist of the following:

- 1 Jar
- 1 Cover
- 1 Hexagonal nut
- 2 Wing nuts
- 2 Washers
- 1 Complete renewal

10. Material for one complete renewal must consist of the following:

- 1 Element
- 1 Can caustic soda
- 1 Bottle battery oil

11. Renewals must not be unpacked except as required.

* The term "as instructed" as used herein refers to individual railroad instructions.

12. Elements must not be lifted or carried by their connecting wires.
13. Packages containing cells or renewals must be kept dry.
14. Caustic soda which has been damaged by exposure to air or dampness must not be used.
15. Care must be exercised in handling the dry soda or mixed solution because caustic soda is a caustic poison which will burn or injure the skin, eyes or clothing. It must never be taken internally. Where the skin is likely to be burned from exposure to caustic soda, it is good practice to protect to some extent the exposed skin by applying a coating of vegetable or animal oil, such as olive, linseed, cottonseed, castor or lard. If these oils are not available, mineral oil is of some value, although not as effective as the oils mentioned. If caustic soda does come in contact with the skin, it should immediately be washed off with plenty of water and neutralized with a weak acid such as vinegar. If a skin burn has resulted from contact with the caustic soda, after washing with water, apply one of the vegetable or animal oils specified herein. Mineral or lubricating oil may also be used but it is not as effective. Should caustic soda get into the eye, immediately wash with plenty of water, flush freely with a pure vegetable oil, such as olive oil, and get to a physician as soon as possible. Where caustic soda has been taken internally, immediately drink vinegar and water in equal parts or lemon juice and water in equal parts, and get to a physician as soon as possible. If clothing becomes wet with caustic soda solution, it should immediately be removed. If the wet portion of the clothing came in contact with the skin, the skin should be treated as recommended herein. Such clothing should be thoroughly washed before it is worn again. The above treatment of caustic burns is that recommended by the manufacturers of caustic soda primary batteries as good first-aid practice until medical assistance can be obtained.

Setting up and renewing cells.

16. Material must be checked to see that jars, covers, nuts, washers, elements, caustic soda and oil are of proper size and quantity.
17. Separators and other packing material must be removed from elements.
18. Elements must be examined to see that they hang approximately in a vertical position, that the electrodes are parallel to each other and uniformly spaced, and that connections are firmly made. Broken or cracked electrodes must not be used.
19. Jars and covers must be thoroughly cleaned. Cracked or defective jars or covers must not be used.
20. Material unfit for use must be called to attention of proper authority for disposition.
21. Clean water must be used for mixing solution. Water containing an excess of metallic salt, acid, alkali, sewage or other impurities must not be used.
22. Jars should be filled with clean water to within approximately $2\frac{3}{4}$ inches from the top or as specified in manufacturer's instructions.
23. Caustic soda must be added gradually and stirred with a circular and pendulum-like movement until thoroughly dissolved, using a clean, untreated strip of wood which should be long enough to reach the bottom of the jar.
24. The exact amount of soda and only that furnished by the manufacturer for the type of renewal must be used.

Setting up and renewing cells.—Continued.

25. Connecting wire and suspension bolt must be passed through holes in cover and element securely tightened to cover by means of hexagonal nut. Two washers and two wing nuts must be placed above the hexagonal nut. Before applying element to cover, bend connecting wire so that it will pass freely through hole in cover to prevent damage to insulation. Avoid bending wire at point where it is connected to electrode.

26. If the cells being set up or renewed are for normally open circuit service or for service where the discharge rate is very low, any special instructions issued by the manufacturer for such service must be followed.

27. Element must be inserted in solution, where practicable, after jars have been placed in permanent position. Where necessary, water must be added to bring top of solution, when cool, $\frac{3}{4}$ inch from top of jar with electrodes in position and stirred thoroughly by agitating entire bulk of solution by a pendulum movement of narrow stick reaching to bottom of jar. Solution must never touch underside of cover but must be well above top of electrodes.

28. Oil of the exact amount and kind furnished by manufacturer of renewal must be added to top of solution after element is permanently in place. Element should not be raised through the oil.

29. Connections must be clean and tight.

30. Except when necessary to make replacements of individual cells, all cells of a battery should be renewed at the same time.

31. Discarded solution, cans and bottles must be disposed of where they will not damage property, inflict injury to persons, animals, etc., nor pollute any stream or source of water supply. Cans should be flattened out when emptied.

32. Exhausted elements must be drained and then spaced on racks, floors, or shelves away from inflammable material until thoroughly dry, after which they must be placed in paper bags, if available, then packed and forwarded to the storehouse or other designated place. Each container to contain only one type and make and plainly marked to show name of shipper, quantity, type and manufacture.

33. Exhausted elements, after being packed, must be kept dry as chemical action, when wet, may cause fire. Containers should be labeled "Keep Dry."

Inspection.

34. Battery must be inspected, tested and renewed as often as necessary. Voltage readings of the battery should be taken during maximum discharge.

35. Any unusual appearance or performance of cells must be promptly reported to proper authority. If cells must be replaced, the old cells, where practicable, should be held intact for instructions as to disposition.

Adjustment of rectifiers used with Type A primary cells.

36. Rectifiers must be adjusted when each cell reads 0.85 volt. New cells reading over 0.85 volt should be brought down to this voltage by temporarily discharging them through a resistance while making the adjustment. Cells which read less than this voltage should be brought up to 0.85 volt by charging the cells for a short period before permanently adjusting rectifiers.

37. When adjusting rectifiers, make sure that the primary cells do not receive more charge than discharge, calculated in ampere hours, over a definite

Adjustment of rectifiers used with Type A primary cells.—Continued.

period of time such as 24 hours. The output of the rectifier should always be slightly less than the entire current requirement of the circuit.

38. If the rectifier is set too high and the cells are being charged, this condition will be indicated by an increase in the thickness of the extreme lower portion of the zinc electrode, or by the formation of a "mossy" deposit on the surface of the electrodes. These warnings will appear depending on the state of exhaustion of the cells as well as upon the rate and duration of the charge long before any permanent damage can be done to the battery.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Instructions for Copper-Oxide Caustic Soda Primary Cells, Manual Part 7.

(Revision of Instructions for Car Retarder Systems)
A.A.R. SIGNAL SECTION INSTRUCTIONS.

CAR RETARDER SYSTEMS*

1952

These instructions apply to the installation, maintenance and test of car retarder systems. They set forth general requirements representing recommended practice.

1. Maintenance, tests and repair work which may interfere with safe operation of cars must not be started until movements have been fully protected. Temporary repairs or adjustments, when required, must be made in such manner that safety of operation will not be impaired. When repair, adjustment, change or replacement is made, tests must be made immediately to determine that the apparatus functions as intended. When making tests of apparatus, proper instruments must be used and it must be known that no unsafe conditions are set up by the application of testing equipment.

2. Each circuit, the functioning of which affects the safety of operation, must be kept free of any ground or combination of grounds as instructed. In no case shall a flow of current be permitted which is equal to or in excess of 75 per cent of the release value of any relay or other electromagnetic device in the circuit.

3. Each wire must be tagged or otherwise marked so it can be identified at each terminal. Nomenclature must correspond to that of the circuit plan. Tags or other marks of identification in instrument cases and apparatus housings must be made of insulating material. Wires, tags, or other markings must not interfere with moving parts of apparatus.

4. Control machine must be kept in good condition, free from dust, grease, dirt and excessive lost motion. Contacts must be kept clean and in proper adjustment.

5. During snow and sleet storms, switches and skates must be kept clear of snow and ice. Where open flame snow melting apparatus is used, care must be exercised to prevent damage to apparatus.

6. Doors, covers and fastenings must be kept in good condition, with suitable gaskets in place.

7. All locks or seals must be maintained as instructed.

8. Apparatus must be maintained as instructed so as to conform to established clearances.

9. Paint must be applied as often as required. Rusty surfaces must be cleaned before painting. Paint must not be applied to threads of screw jaws, adjustable screws, cotters or gaskets. Paint or oil must not be applied to friction surfaces of retarder shoes or skates.

* The term "as instructed" as used herein refers to individual railroad instructions.

10. Movable parts must be kept clean and free from foreign material, properly adjusted and lubricated as instructed.

11. Bolts, nuts, dowel pins, pins and cotters of proper size and type must be kept in place, nuts and dowel pins kept tight and cotters properly spread.

12. Parts which fail to perform their intended functions must be promptly adjusted, repaired or replaced.

13. Lightning arresters and made grounds must be properly connected, maintained and tested as instructed.

14. Threads of rods, jaws and bolts must be kept clean and properly lubricated.

15. Retarders, switch and skate operating mechanisms must be kept in good condition and free from excessive lost motion. Manufacturer's instructions as to adjustments and maintenance must be followed unless they conflict with other general or detailed instructions, in which case proper authority must be consulted. All bearing parts must be kept properly lubricated. Lubricants used should be suitable to the weather encountered and should be in accordance with the recommendation of the manufacturer. Contacts must be kept clean and properly adjusted.

16. Grease and dirt should be cleaned off the top of retarder beams and shoes and from beneath the shoes and the rails, and from underneath the operating parts.

17. Height of retarder shoes above the rail and distance between retarder shoes with retarder in open position must be maintained as instructed.

18. Retarder shoes must be replaced when worn out and care must be used when installing new or partially worn shoes to insure that one does not project beyond an adjacent shoe far enough for a wheel to hit and be lifted. Broken shoes which leave such a projection must be changed immediately.

19. When retarder shoes or beams are removed from one section of a retarder while the remainder of the machine is kept in service, tapered end shoes must be used or equivalent protection provided, as instructed, at both ends of the operable section so that a car wheel will enter the shoes without lifting.

20. Power-operated skate mechanism must be tested after each skate replacement to make certain it is functioning as intended.

21. Skates must be inspected periodically to insure that points are not bent or broken and that friction surfaces are in good condition.

22. Cells and batteries must be maintained and tested in accordance with Instructions for Cells and Batteries, Manual Parts 7 and 14.

23. Electric lamps must be maintained and tested in accordance with Instructions for Incandescent Electric Lamps, Manual Part 120.

24. Insulated rail joints must be maintained and tested in accordance with Instructions for Insulated Rail Joints, Manual Part 133.

25. Rectifiers and motor-generators must be maintained and tested in accordance with Instructions for Rectifiers and Motor-Generators, Manual Part 68.

26. Relays must be maintained and tested in accordance with Instructions for Relays, Manual Parts 124 and 126.

27. Signals must be maintained and tested in accordance with Instructions for Light and Semaphore Signals, Manual Part 54.

28. Switch circuit controllers must be maintained and tested in accordance with Instructions for Switch Circuit Controllers, Manual Part 134.

29. Track circuits must be maintained and tested in accordance with Instructions for Track Circuits, Manual Part 8.

30. Wire and cable must be maintained and handled in accordance with Instructions for Wire and Cable, Manual Part 190.

31. Insulation resistance tests must be made in accordance with Instructions for Insulation Resistance, Manual Part 130.

32. Ground resistance test must be made in accordance with Instructions for Made Grounds, Manual Part 61.

33. Electro-pneumatic car retarders must be maintained in accordance with Instructions for Interlockings (Instructions 59 to 69, inclusive), Manual Part 138.

34. Electric car retarders must be maintained in accordance with Instructions for Interlockings (Instructions 70 to 76, inclusive), Manual Part 138.

35. Results of inspections and tests herein required and all other inspections and tests that may be required must be recorded as instructed.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Instructions for Car Retarder Systems, Manual Part 125.

(Revision of Instructions for Insulation Resistance)
A.A.R. SIGNAL SECTION INSTRUCTIONS.

INSULATION RESISTANCE*

1952

These instructions apply to the measurement of insulation resistance for wires, cables and associated equipment. They set forth general requirements representing recommended practice.

General.

1. Tests which may interfere with safe operation of trains must not be started until train movements have been fully protected. Temporary repairs, when required, must be made in such manner that safety of train operation will not be impaired. When repair, change or replacement is made, tests must be made immediately to determine that the apparatus functions as intended. When making tests, proper instruments must be used and it must be known that no unsafe conditions are set up by the application of testing equipment.

2. Electrostatic capacitance should be discharged by shorting the circuit, or by grounding the conductor, before and after making a test to avoid receiving a shock or damaging the apparatus.

3. Insulation resistance tests must be made as required when wires, cables or insulated parts are dry.

Instruments.

4. Direct reading instrument having a self-contained source of direct current test voltage must be used. Manufacturer's instructions for using instruments must be followed.

Range and voltage.

5. For circuits and apparatus of first, second and third voltage ranges (up to 250 volts) the instrument should be rated not less than zero to 20 megohms and 250 volts. For signal power cables and other circuits and apparatus of fourth and fifth voltage ranges (up to 660 volts and over), the instrument should be rated not less than zero to 100 megohms and 500 volts and may be rated as high as zero to 2,000 megohms and 1,000 volts.

Test leads.

6. Single-conductor stranded wire, having high quality insulation, with lugs for connecting to the instrument and suitable clips for connecting to apparatus under test should be used. They must be checked as follows:

- (a) Connect leads to the instrument binding posts, twist the insulated portion of the leads loosely together and see that terminals at the free ends are separated and clear of all objects.

* The term "as instructed" as used herein refers to individual railroad instructions.

Test leads.—Continued.

(b) Operate the instrument as directed and if the leads are properly insulated, the pointer should read infinity on the scale, indicating no leakage between leads.

(c) If any leakage exists, other leads must be obtained and tested in the same manner.

Electrostatic capacitance.

7. In testing any apparatus or circuit having an appreciable amount of electrostatic capacitance, a constant voltage type of instrument should be used and operated a sufficient length of time for the pointer to attain a maximum value before taking the reading.

Procedure.

8. Test each circuit separately or, where practicable, a group of circuits, all of which are electrically connected at the time of test, as follows:

(a) Circuit under test must be de-energized.

(b) Connect one terminal of instrument to one wire or part of the inter-connected circuit or circuits and the other terminal to ground and operate the instrument as directed.

(c) To determine the continuity of the circuit under test in a multiple cable, each wire should be tested to ground before measuring for leaks from one conductor to another.

(d) Multiple conductor cable must also be tested by connecting one terminal of the instrument to the conductor under test and the other terminal of instrument to all other conductors in the cable.

(e) If the circuit or circuits under test are found to have an insulation resistance lower than required for any one circuit in the group, the circuit or circuits must be segregated and test repeated until defect is found.

(f) When the insulation resistance is found to be lower than required, the defect must be repaired, or the wire or part replaced promptly and another test made.

(g) Test of insulation resistance should be made of complete circuit wherever possible so as to check all wires, cables and associated equipment.

9. The results of tests of insulation resistance must be recorded as instructed.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Instructions for Insulation Resistance, Manual Part 130.

(Revision of Instructions for Facing Point Locks Applied to Spring Switches)
A.A.R. SIGNAL SECTION INSTRUCTIONS.

FACING POINT LOCKS APPLIED TO SPRING SWITCHES*

1952

These instructions apply to the installation, maintenance and test of facing point locks applied to spring switches. They set forth general requirements representing recommended practice.

1. Maintenance, tests and repair work which may interfere with safe operation of trains must not be started until train movements have been fully protected. Temporary repairs or adjustments, when required, must be made in such manner that safety of train operation will not be impaired. When repair, adjustment, change or replacement is made, tests must be made immediately to determine that the apparatus functions as intended. When making tests of apparatus, proper instruments must be used and it must be known that no unsafe conditions are set up by the application of testing equipment.

2. Facing point lock mechanism, tie plates, gage plates and crank stand must be kept securely fastened to the ties.

3. Special rail stop must be securely fastened to the switch point and the switch should be free and in proper alignment so that the rail stop will bear positively against the stock rail when the switch is thrown slowly to the normal position by hand, and also return against the stock rail after the switch has been pried away by means of a bar inserted as near the stop as possible.

4. Connections operating the locking plunger must be kept tight and the end of plunger must have square edges.

5. Holes or notches in lock rods must have square edges and must be not more than $\frac{3}{16}$ inch larger than plunger.

6. Lock rods must be so maintained that when switch is operated by hand toward its normal position, the plunger will not enter the lock rod if the switch point is prevented by an obstruction from closing to within $\frac{1}{4}$ inch.

7. Point detector must be so maintained that when switch mechanism is locked in normal or reverse position, contacts cannot be opened by manually applying force at the closed switch point. Point detector circuit controller must be so maintained that the contacts will not assume the position corresponding to switch point closure if the switch point is prevented by an obstruction from closing to within $\frac{1}{4}$ inch where latch-out device is not used and to within $\frac{3}{8}$ inch where latch-out device is used.

8. Tests must be made, as instructed, to determine that end of locking plunger is withdrawn from the lock rod without binding.

9. Locking plunger contacts must be so maintained that disconnection of the locking plunger connection at its point of attachment to the switch, when

* The term "as instructed" as used herein refers to individual railroad instructions.

the switch and switch operating mechanism are in normal position, must either:

(a) Prevent contacts from assuming the position indicating point closure, or

(b) Operate other contacts to indicate separately that plunger has over-traveled.

10. Facing point mechanism must be maintained and adjusted in accordance with manufacturer's instructions unless they conflict with any other instructions, in which case proper authority must be consulted for correct procedure.

11. Results of inspections and tests herein required and all other inspections and tests that may be required must be recorded as instructed.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Instructions for Facing Point Locks Applied to Spring Switches,
Manual Part 159.

COOPERATIVE REPORT

AMERICAN STANDARDS ASSOCIATION DEFINITIONS OF ELECTRICAL TERMS PROJECT C42—SUBGROUP 8

F. Youngwerth, Representative

Advance copies of Sections 46, 51 and 56 of American Standards Association Group C42, definitions of electrical terms, were reviewed and screened against A.A.R. Signal Section Manual Part 55 and against definitions as contained in the Rules, Standards and Instructions of the Interstate Commerce Commission.

Revised drafts of aforementioned sections were submitted to the Secretary of the A.S.A. for printing and distribution to members of A.S.A. Sectional Committee C42, certain Chairmen of A.I.E.E. Technical Committees, Chairmen of other A.S.A. Sectional Committees and the National Security Resource Board for their review and comment. To date printed copies for final checking have not been received.

Your representative has received printed copies of drafts from 15 other A.S.A. subgroups. These drafts have been reviewed and comments referred to the appropriate Subcommittee Chairmen for their further consideration.

Action Recommended

Acceptance as information.

COMMITTEE VI—DESIGNS

Personnel

W. G. Brown, Chairman

C. J. R. Taylor, Vice-Chairman

H. Alexander	H. P. Schmidt
R. I. Becksted	P. E. Snead
E. F. Brown	D. B. Thomas
W. A. Ford	C. C. Thorn
B. C. Hollowell	T. W. Tizzard
W. T. Lewis	C. H. Tobin
J. C. Lummis	C. N. Tymeson
J. M. Rice	A. J. Yarrell

Signal Section, A.A.R.:

The following outline of work has been assigned:

1. Revision of Manual.
2. Indexing signal literature.
3. Designs.
4. Specifications and drawings covering reflector lenses and similar devices for signals and signs, collaborating with Committee VIII.
5. Simplification of sizes and kinds of electric lamps for signal purposes, cooperating with Purchases and Stores Division, A.A.R.
6. Specification for concrete for shop precast and poured in place foundations.
7. Design a universal switch adjustment bracket.
8. Design a universal adjustment bracket for application of lock rod to front rod.
9. Investigate and report on means and methods for the improvement of incandescent electric lamps used in signaling, collaborating with Committee I.
10. Design an electric switch lamp.
11. Specifications for plain and spring lock washers.

The Committee submits for consideration, reports on the following subjects*:

1. Revised drawings.
Revision of Specification 51-49, Manual Part 91.
Revision of Specification 231-50, Manual Part 237.
3. New drawings.
Cooperative report. American Standards Association—Standardization and Unification of Screw Threads—Project B1.

* Suggestions or criticisms should be submitted in writing to the Chairman of the Committee on or before September 1, 1952.

Information

Specifications, etc., of other organizations referred to in the report of this Committee may be procured from the following:

A.S.A.—American Standards Association, 70 E. 45 St., New York 17, N. Y.
A.S.T.M.—American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.

Disposition of 1951 Letter Ballot Subjects

The following subjects presented by Committee VI at the 1951 Annual Meeting were submitted to letter ballot and officially approved:

Specification 231-51—"No Right Turn"—"No Left Turn" Illuminated Sign—Now in Manual Part 237.

Specification 155-51—Railroad Highway Grade Crossing Signs—Now in Manual Part 44.

Specification 255-51—Reflex-Reflecting Sheet Material—Now in Manual Part 276.

A.A.R. Sig. Sec. 1642F—Railroad Crossing Sign—90 Degree Reflector Type for 4 to 8-Inch Pipe—Assembly—Now in Drawing Section of Manual.

A.A.R. Sig. Sec. 1645E—Number of Tracks Sign—Reflector Type for 4 to 8-Inch Pipe—Assembly—Now in Drawing Section of Manual.

A.A.R. Sig. Sec. 1646E—Stop on Red Signal Sign—Reflector Type for 4 to 8-Inch Pipe—Assembly—Now in Drawing Section of Manual.

A.A.R. Sig. Sec. 1648E—Stop When Swinging Sign—Reflector Type for 4 to 8-Inch Pipe—Assembly—Now in Drawing Section of Manual.

A.A.R. Sig. Sec. 1692D—Railroad Crossing Sign—50 Degree Reflector Type for 4 to 8-Inch Pipe—Assembly—Now in Drawing Section of Manual.

A.A.R. Sig. Sec. 1643F—Front Plates for Railroad Crossing Sign—90 Degree Reflector Unit Type—Details—Now in Drawing Section of Manual.

A.A.R. Sig. Sec. 1693E—Front Plates for Railroad Crossing Sign—50 Degree Reflector Unit Type—Details—Now in Drawing Section of Manual.

A.A.R. Sig. Sec. 1702B—Front and Back Plates for Stop on Red Signal Sign—Reflector Unit Type—Details—Now in Drawing Section of Manual.

A.A.R. Sig. Sec. 1703B—Front and Back Plates for Stop When Swinging Sign—Reflector Unit Type—Details—Now in Drawing Section of Manual.

A.A.R. Sig. Sec. 1700B—Front and Back Plates for Number of Tracks Sign—Reflector Unit Type—Details—Now in Drawing Section of Manual.

A.A.R. Sig. Sec. 1462B—Highway Crossing Signal—Flashing Light Type with Extended Lights and Pedestal Mounted Gate—Assembly—Now in Drawing Section of Manual.

A.A.R. Sig. Sec. 1489E—Highway Crossing Signal—Flashing Light Type with Suspended Lights and Mast Mounted Gate—Assembly—Now in Drawing Section of Manual.

A.A.R. Sig. Sec. 1691E—Highway Crossing Sign—50 Degree Reflector Type—Assembly—Now in Drawing Section of Manual.

A.A.R. Sig. Sec. 1651F—Highway Crossing Signal—Wig-Wag Type with Stop When Swinging Sign—Assembly—Now in Drawing Section of Manual.

A.A.R. Sig. Sec. 1652F—Highway Crossing Signal—Wig-Wag Type with Stop Sign—Assembly—Now in Drawing Section of Manual.

- A.A.R. Sig. Sec. 1653F—Highway Crossing Signal—Flashing Light Type with Stop on Red Signal Sign—Assembly—Now in Drawing Section of Manual.
- A.A.R. Sig. Sec. 1654F—Highway Crossing Signal—Flashing Light Type with Stop Sign—Assembly—Now in Drawing Section of Manual.
- A.A.R. Sig. Sec. 1686F—Highway Crossing Signal—Flashing Light Type, 6 Ft. and 8 Ft. Cantilever Span—Assembly—Now in Drawing Section of Manual.
- A.A.R. Sig. Sec. 1688D—Highway Crossing Signal—Flashing Light Type, 10 Ft. and 12 Ft. Cantilever Span—Assembly—Now in Drawing Section of Manual.
- A.A.R. Sig. Sec. 1705A—Front Plates for 50 Degree Railroad Crossing Sign—Reflex-Reflecting Sheet Type for Back Plates 17041 and 17042—Details—Now in Drawing Section of Manual.
- A.A.R. Sig. Sec. 1706A—Front Plates for 90 Degree Railroad Crossing Sign—Reflex-Reflecting Sheet Type for Back Plates 17011 and 17012—Details—Now in Drawing Section of Manual.
- A.A.R. Sig. Sec. 1707A—Front Plates for Number of Tracks Sign—Reflex-Reflecting Sheet Type for Back Plate 17001—Details—Now in Drawing Section of Manual.
- A.A.R. Sig. Sec. 1708A—Front Plate for Stop on Red Signal Sign—Reflex-Reflecting Sheet Type for Back Plate 17021—Detail—Now in Drawing Section of Manual.
- A.A.R. Sig. Sec. 1709A—Front Plate for Stop When Swinging Sign—Reflex-Reflecting Sheet Type for Back Plate 17031—Detail—Now in Drawing Section of Manual.
- A.A.R. Sig. Sec. 1715A—50 Degree Railroad Crossing Sign—Reflex-Reflecting Sheet Type for 4 to 8-Inch Pipe—Assembly—Now in Drawing Section of Manual.
- A.A.R. Sig. Sec. 1716A—Plates for 50 Degree Railroad Crossing Sign—Reflex-Reflecting Sheet Type—Details—Now in Drawing Section of Manual.
- A.A.R. Sig. Sec. 1717A—90 Degree Railroad Crossing Sign—Reflex-Reflecting Sheet Type for 4 to 8-Inch Pipe—Assembly—Now in Drawing Section of Manual.
- A.A.R. Sig. Sec. 1718A—Plates for 90 Degree Railroad Crossing Sign—Reflex-Reflecting Sheet Type—Details—Now in Drawing Section of Manual.
- A.A.R. Sig. Sec. 1719A—Number of Tracks Sign—Reflex-Reflecting Sheet Type for 4 to 8-Inch Pipe—Details and Assembly—Now in Drawing Section of Manual.
- A.A.R. Sig. Sec. 1720A—Stop on Red Signal Sign—Reflex-Reflecting Sheet Type for 4 to 8-Inch Pipe—Details and Assembly—Now in Drawing Section of Manual.
- A.A.R. Sig. Sec. 1721A—Stop When Swinging Sign—Reflex-Reflecting Sheet Type for 4 to 8-Inch Pipe—Details and Assembly—Now in Drawing Section of Manual.
- A.A.R. Sig. Sec. 1712A—Letters—Rounded Type—5½ Inch—Details—Now in Drawing Section of Manual.
- A.A.R. Sig. Sec. 1713A—Letters—Rounded Type—4 Inch—Details—Now in Drawing Section of Manual.
- A.A.R. Sig. Sec. 1714A—Numerals—Rounded Type—5½ Inch—Details—Now in Drawing Section of Manual.

REVISED DRAWINGS

- A.A.R. Sig. Sec. 1055E—Switch-Rod Insulation.
Arranged to conform to A.R.E.A. Plan No. 222.
- A.A.R. Sig. Sec. 1245B—Pinnacles—for 4, 5, 6 and 8 Inch Mast—Details and Assemblies.
Arranged to include pinnacles for 6 and 8-inch pipe.
- A.A.R. Sig. Sec. 1271B—Ball Studs—for Switch Circuit Controller—Details and Assemblies.
- A.A.R. Sig. Sec. 1272B—Ball Socket Screw Jaw—for Switch Circuit Controller—Details and Assemblies.
Titles and details changed in accordance with latest practice.
- A.A.R. Sig. Sec. 1364E—Ladder Platforms—Details and Assemblies.
- A.A.R. Sig. Sec. 1399D—Low Target Stand—Details and Assembly.
- A.A.R. Sig. Sec. 1447B—Base for 5 Inch Mast—For Heavy Loading.
Details changed in accordance with latest practice.
- A.A.R. Sig. Sec. 1463B—Cross-Arm for Extended Lights—for Flashing Light Highway Crossing Signal with Pedestal Mounted Gate—Assembly.
- A.A.R. Sig. Sec. 1468B—Cross-Arm for Suspended Lights—for Flashing Light Highway Crossing Signal with Mast Mounted Gate—Assemblies.
Titles and details changed in accordance with latest practice.
- A.A.R. Sig. Sec. 1489F—Highway Crossing Signal—Flashing Light Type with Suspended Lights and Mast Mounted Gate—Assembly.
Details changed in accordance with latest practice.
- A.A.R. Sig. Sec. 1491E—Highway Crossing Gate Roadway Arm—for Mast Mounting.
- A.A.R. Sig. Sec. 1492B—Highway Crossing Gate Sidewalk Arm—for Mast Mounting.
- A.A.R. Sig. Sec. 1647E—Single Adapter Clamp—for Signs—4 to 8 Inch Pipe—Details.
- A.A.R. Sig. Sec. 1656E—Cross-Arm for Suspended Lights for Flashing Light Highway Crossing Signals without Gates—4 to 8 Inch Pipe—Assemblies.
Titles and details changed in accordance with latest practice.
- A.A.R. Sig. Sec. 1657E—Cross-Arms—for Flashing Light Highway Crossing Signals—4 to 8 Inch Pipe—Details.
- A.A.R. Sig. Sec. 1696B—Extension Brackets for Crossing Signs.
- A.A.R. Sig. Sec. 1542B—Incandescent Electric Lamps—Bases.
Details changed in accordance with latest practice.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

- A.A.R. Sig. Sec. 1055D—Switch-Rod Insulation.
A.A.R. Sig. Sec. 1245A—Short Pinnacles.
A.A.R. Sig. Sec. 1271A—Ball Studs—Details and Assemblies.
A.A.R. Sig. Sec. 1272A—Ball Socket Screw Jaw.
A.A.R. Sig. Sec. 1364D—Ladder Platforms—Details and Assemblies.
A.A.R. Sig. Sec. 1399C—Low Target Stand—Details and Assembly.
A.A.R. Sig. Sec. 1447A—Base for 5-Inch Mast for Heavy Loading.
A.A.R. Sig. Sec. 1463A—Cross-Arm for Extended Lights for Flashing Light Highway Crossing Signal with Pedestal Mounted Gate—Assembly.
A.A.R. Sig. Sec. 1468A—Cross-Arm for Suspended Lights for Flashing Light Highway Crossing Signal with Mast Mounted Gate—Assembly.
A.A.R. Sig. Sec. 1489E—Highway Crossing Signal—Flashing Light Type with Suspended Lights and Mast Mounted Gate—Assembly.
A.A.R. Sig. Sec. 1491D—Highway Crossing Gate Arm.
A.A.R. Sig. Sec. 1492A—Crossing Gate Sidewalk Arm.
A.A.R. Sig. Sec. 1647D—Single Adapter Clamp and Details for Crossing Signs for 4 to 8-Inch Pipe.
A.A.R. Sig. Sec. 1656D—Cross-Arms for Flashing Light Highway Crossing Signals without Gates—4 to 8 Inch Pipe—Assemblies.
A.A.R. Sig. Sec. 1657D—Cross-Arms for Flashing Light Highway Crossing Signals—4 to 8 Inch Pipe—Details.
A.A.R. Sig. Sec. 1696A—Extension Brackets for Crossing Signs.
A.A.R. Sig. Sec. 1542A—Incandescent Electric Lamps—Bases.

NEW DRAWINGS

- A.A.R. Sig. Sec. 1471A—Junction Box Base for 5 Inch Mast—for Heavy Loading—Assembly.
A.A.R. Sig. Sec. 1472A—Junction Box Base for 5 Inch Mast—for Heavy Loading—Details.

Drawings prepared to provide for base as specified on A.A.R. Sig. Sec. 1489F and as otherwise required.

- A.A.R. Sig. Sec. 1513A—Take or Leave Siding Roundel—for Illuminated Indicator.

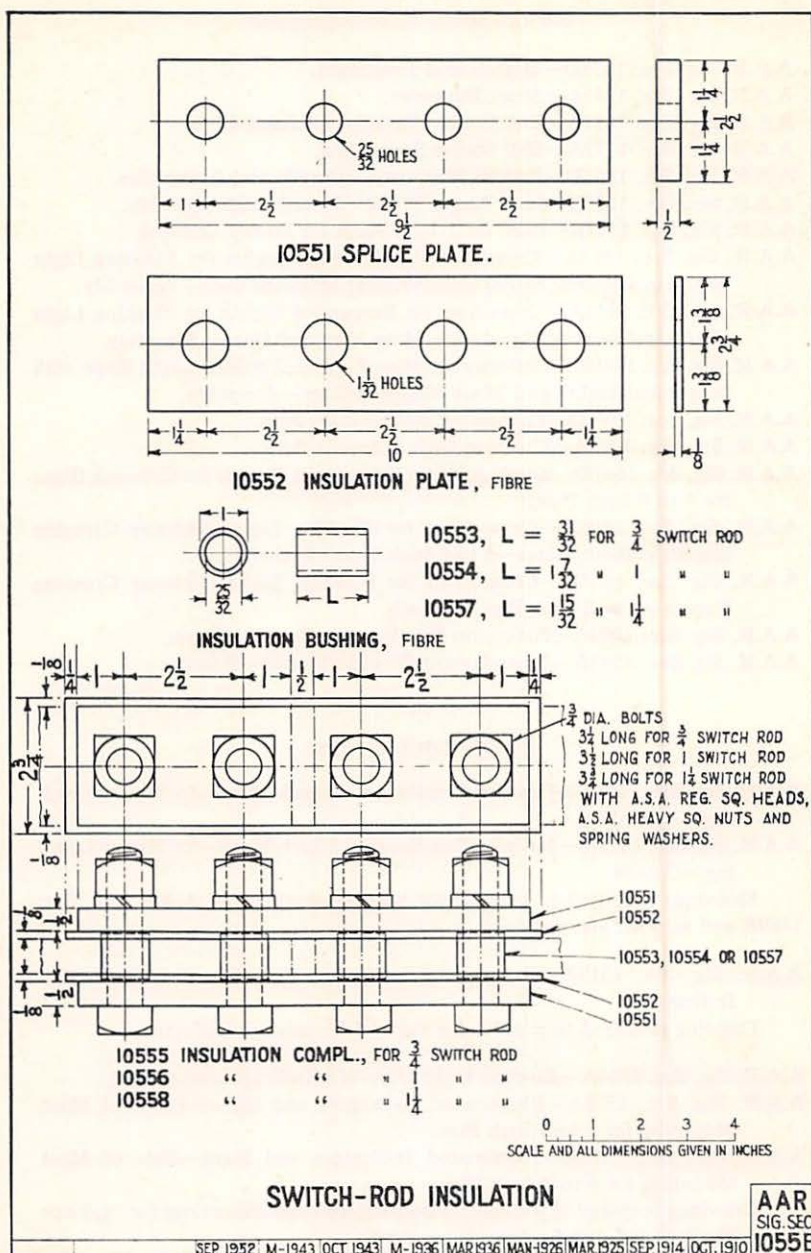
Drawing prepared to provide for roundel for modern indicator.

- A.A.R. Sig. Sec. 1514A—Electric Light Unit—for Indicators and Signs.
A.A.R. Sig. Sec. 1515A—Illuminated Indicators and Signs—Front of Mast Mounting for 4 to 8 Inch Pipe.
A.A.R. Sig. Sec. 1516A—Illuminated Indicators and Signs—Side of Mast Mounting for 4 to 8 Inch Pipe.

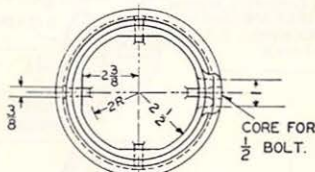
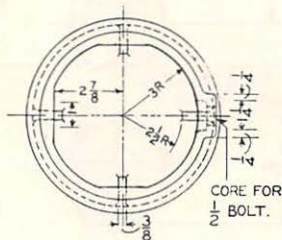
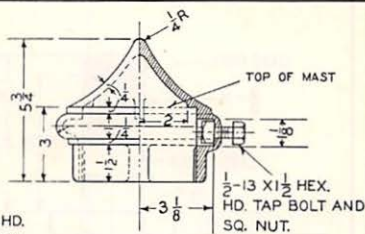
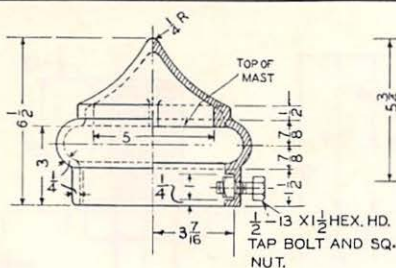
Drawings prepared to provide for housing unit and mountings for "take or leave siding" roundel and others as required.

Action Recommended

Acceptance for submission to letter ballot.

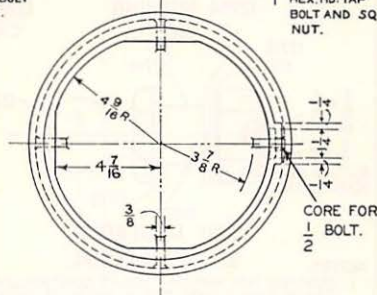
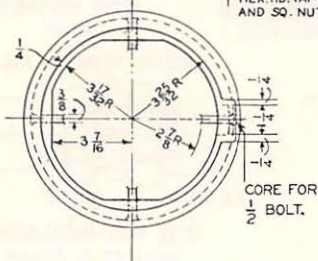
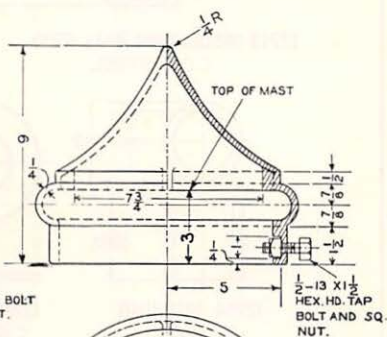
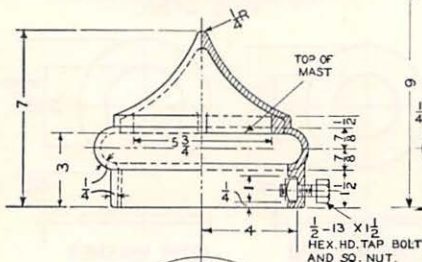


Switch-rod insulation shall conform to detail 3001, A.R.E.A. Plan No. 222.



12452 4 INCH PINNACLE

12451 5 INCH PINNACLE



12453 6 INCH PINNACLE

12454 8 INCH PINNACLE

0 3 6
SCALES AND ALL DIMENSIONS GIVEN IN INCHES

MATERIAL: CAST IRON

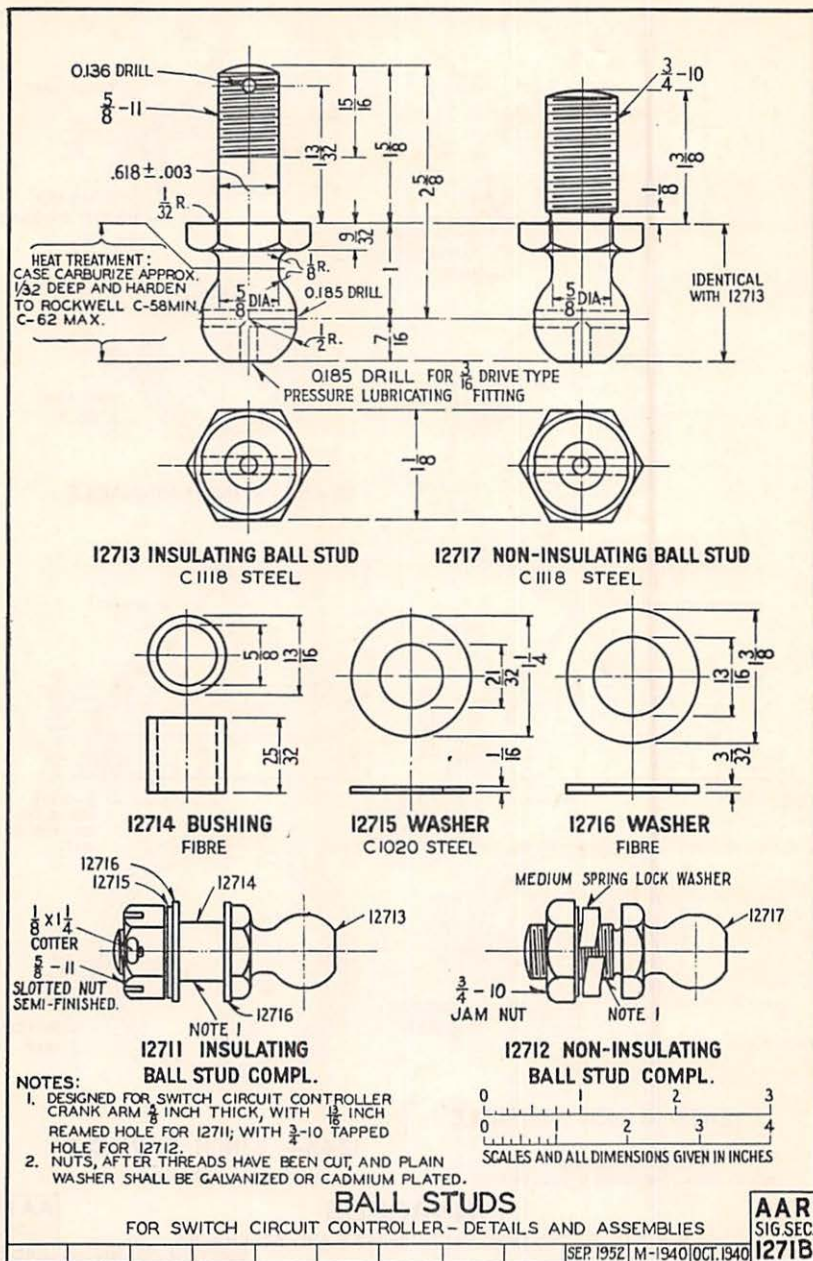
PINNACLES

FOR 4-5-6 AND 8 INCH MAST—DETAILS AND ASSEMBLIES

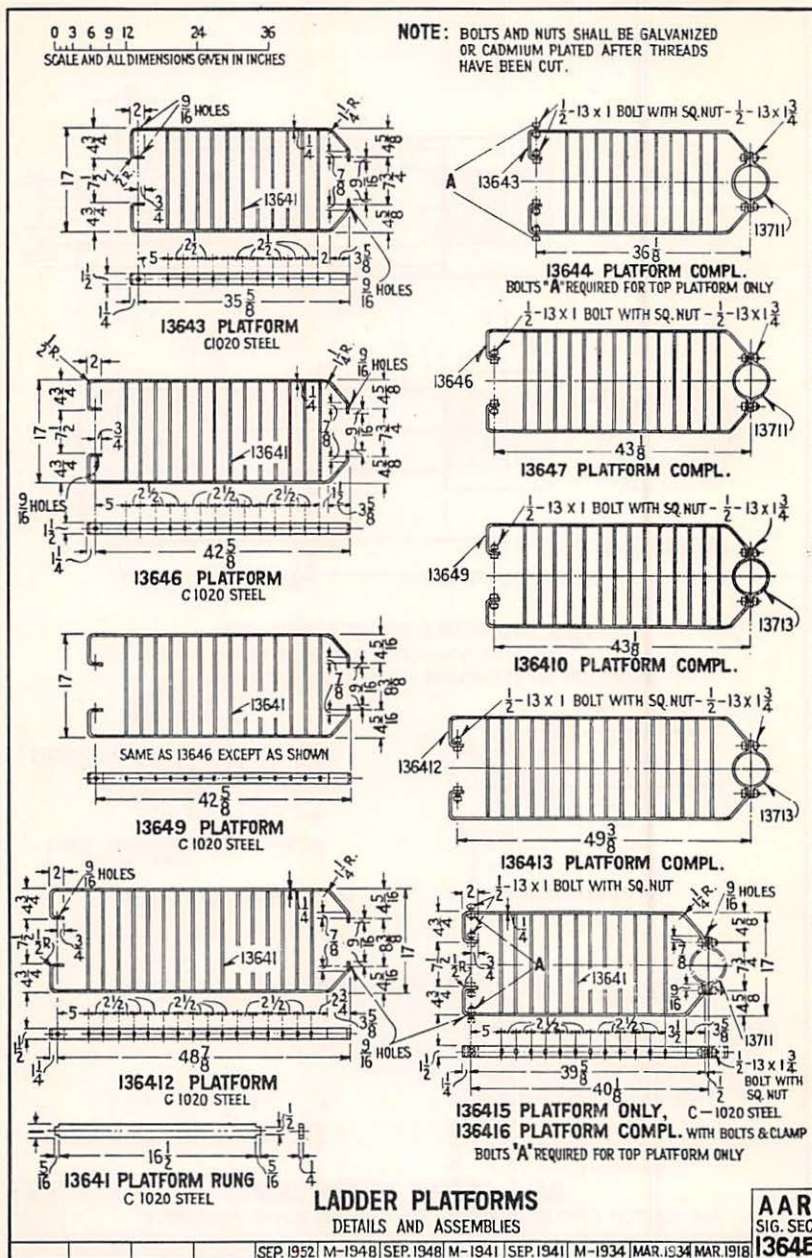
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1245 B

SEP 1952 MAR 1935 MAR 1935

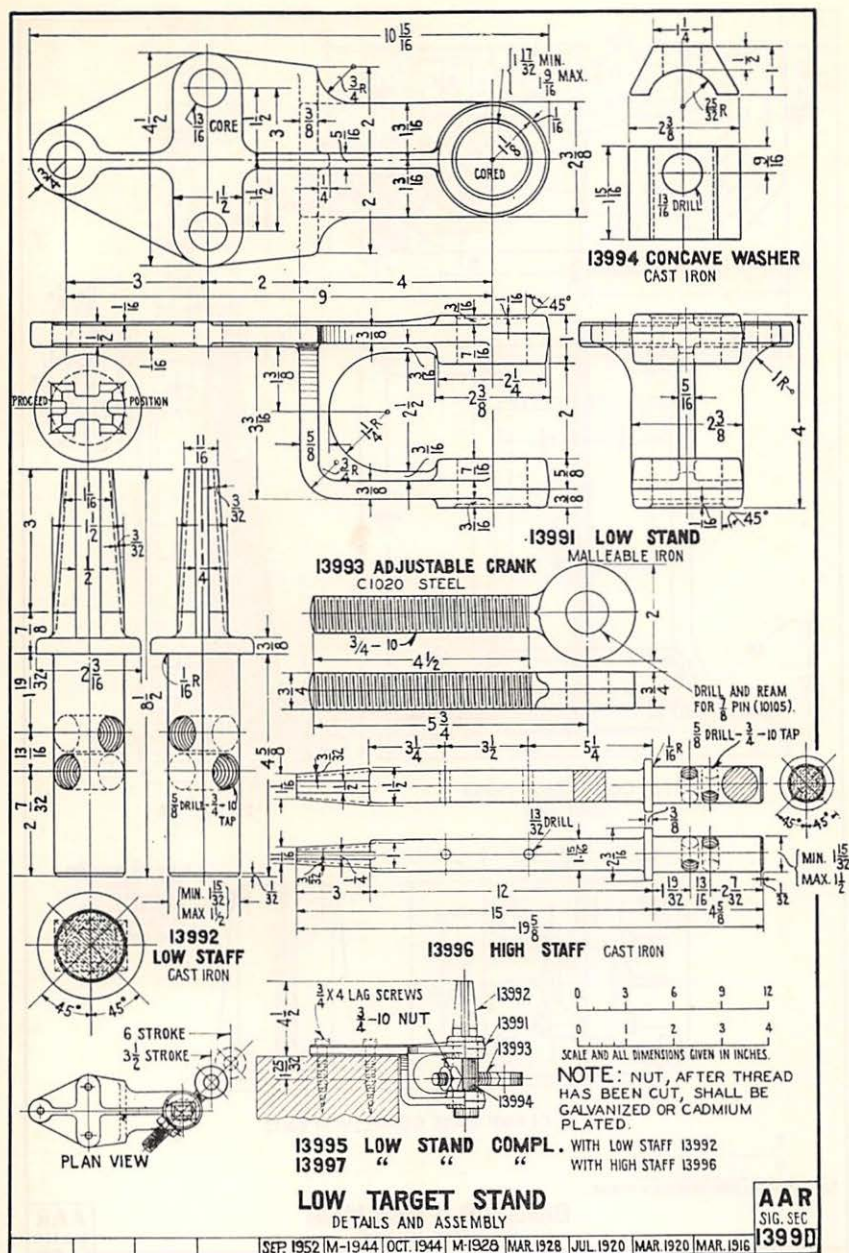
Cast iron shall be Class 20 in accordance with Specification for Gray Iron Castings, Manual Part 88.



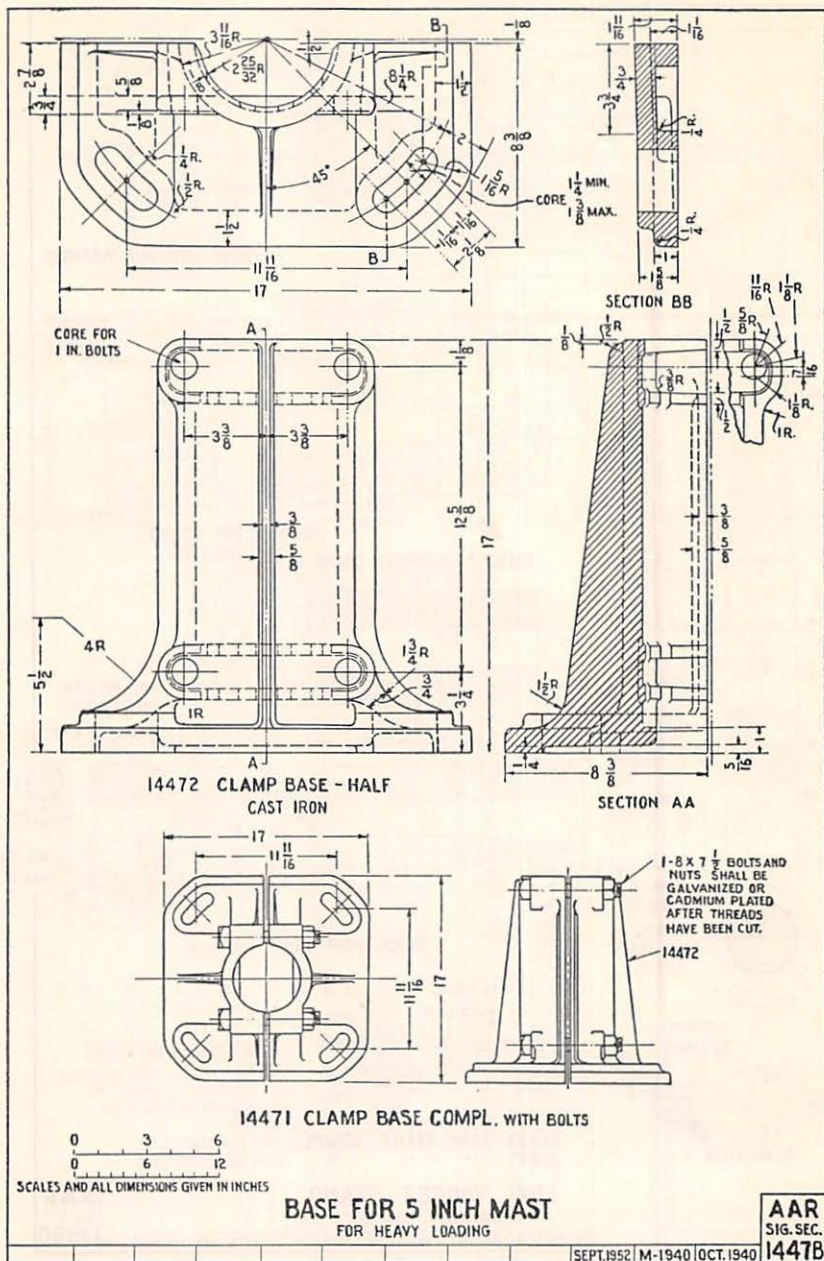
Fibre shall be in accordance with Specification 13, Manual Part 58; Spring lock washers shall be of carbon steel (A.S.A. current Specification B27.1 is preferred, where practicable); Nuts and threads shall be in accordance with Specifications for Bolts, Nuts and Threads, Manual Part 17.



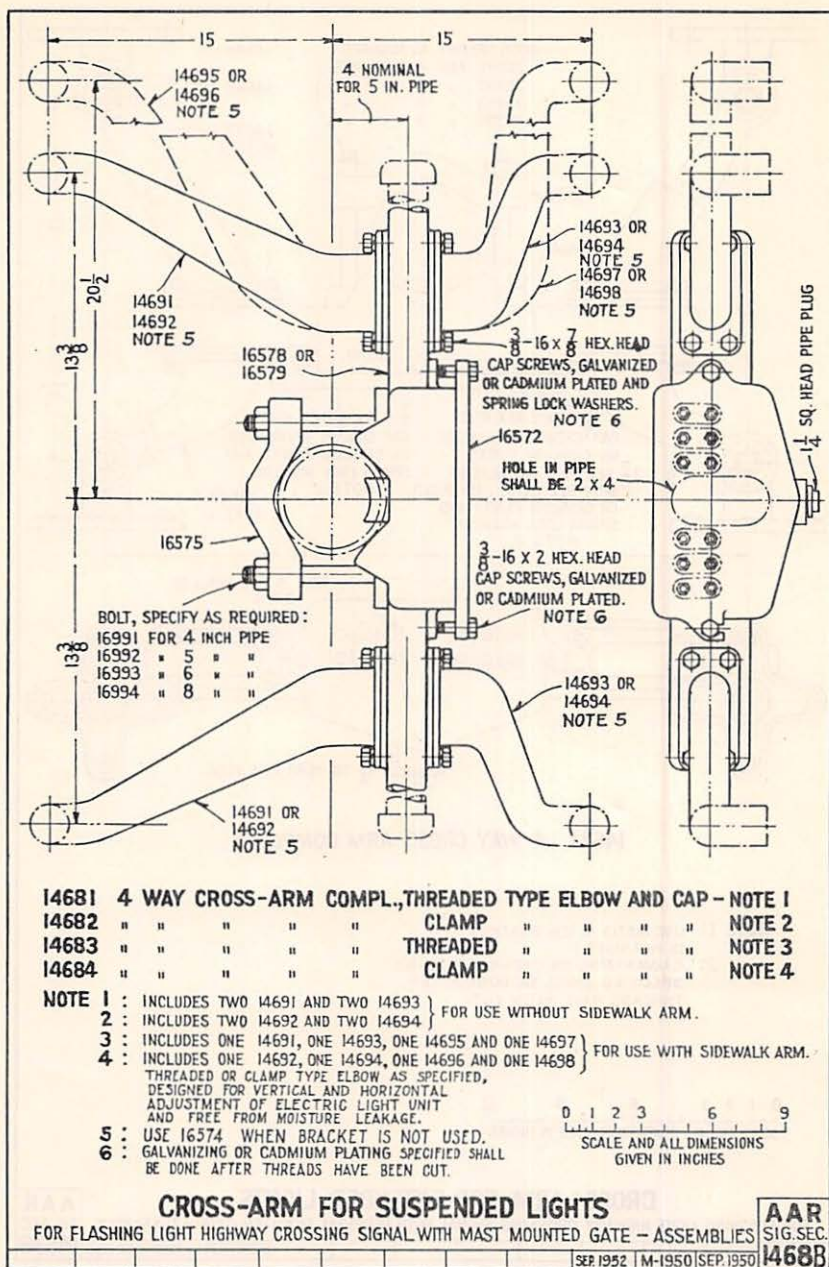
Bolts, nuts and threads shall be in accordance with Specifications for Bolts, Nuts and Threads, Manual Part 17; Painting shall be in accordance with Specification 120, Manual Part 110.



Cast iron shall be Class 20 in accordance with Specification for Gray Iron Castings, Manual Part 88; Malleable iron shall be Grade 32510 in accordance with Specification for Malleable Iron Castings, Manual Part 89; Nut and threads shall be in accordance with Specifications for Bolts, Nuts and Threads, Manual Part 17; Painting shall be in accordance with Specification 120, Manual Part 110.



Cast iron shall be in accordance with Specification for Gray Iron Castings, Manual Part 88; Bolts, nuts and threads shall be in accordance with Specifications for Bolts, Nuts and Threads, Manual Part 17; Painting shall be in accordance with Specification 120, Manual Part 110.



Bolts, nuts and threads shall be in accordance with Specifications for Bolts, Nuts and Threads, Manual Part 17; Spring lock washers shall be of carbon steel (A.S.A. current Specification B27.1 is preferred, where practicable).

NOTE 1: ELECTRIC LIGHT UNITS AAR SIG. SEC.
SPEC. 236, MANUAL PART 263.

NOTE 2: 16961 WITH SIDEWALK ARM ON TRACK SIDE
AS SHOWN.

NOTE 3: 16963 WITH SIDEWALK ARM ON FIELD SIDE.
1/2 X 3 1/2 BOLT WITH NUT, PLAIN WASHER
AND EXTRA HEAVY SPRING LOCK WASHER.
BOLT, NUT AND PLAIN WASHER SHALL BE
GALVANIZED OR CADMIUM PLATED AFTER
THREADS HAVE BEEN CUT.

16404 MODIFIED,
16428, 16429,
164210 OR 17171

16444, 164512, 164513,
164514 OR 17191

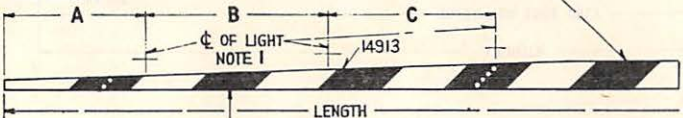
14681, 14682, 14683. OR 14684

ELECTRIC LIGHT UNITS AAR SIG. SEC.
SPEC. 190, MANUAL PART 166 OR
AAR SIG. SEC. SPEC. 232, MANUAL
PART 244.

16467, 16468,
16469 OR 17201

ELECTRIC MOTOR MECHANISM AND
GATE ARM AAR SIG. SEC. SPEC. 139,
MANUAL PART 194.

SPECIFY DIMENSIONS A-B-C
AND LENGTH



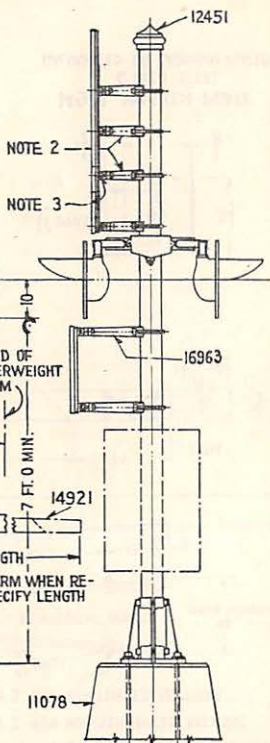
3 FT. 0 MIN.
4 FT. 0 MAX.

TOP OF FOUNDATION
6 IN. ABOVE CROWN OF HIGHWAY

5 INCH PIPE
12 FT. 10 LONG
14711, 14712 OR 14471

SIDEWALK ARM WHEN RE-
QUIRED, SPECIFY LENGTH

0 12 24 36 48 60 72
SCALE AND ALL DIMENSIONS GIVEN IN INCHES
UNLESS OTHERWISE INDICATED.



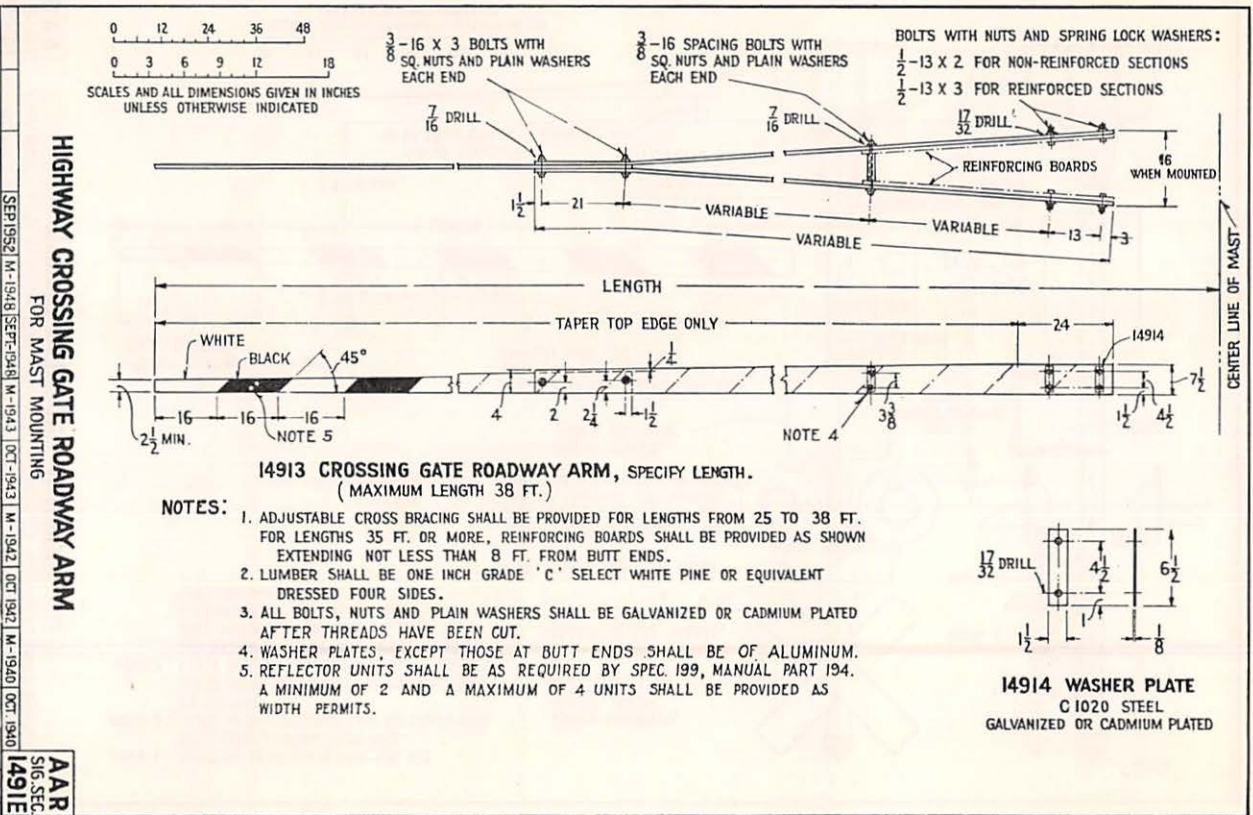
HIGHWAY CROSSING SIGNAL

FLASHING LIGHT TYPE WITH SUSPENDED LIGHTS AND MAST MOUNTED GATE—ASSEMBLY

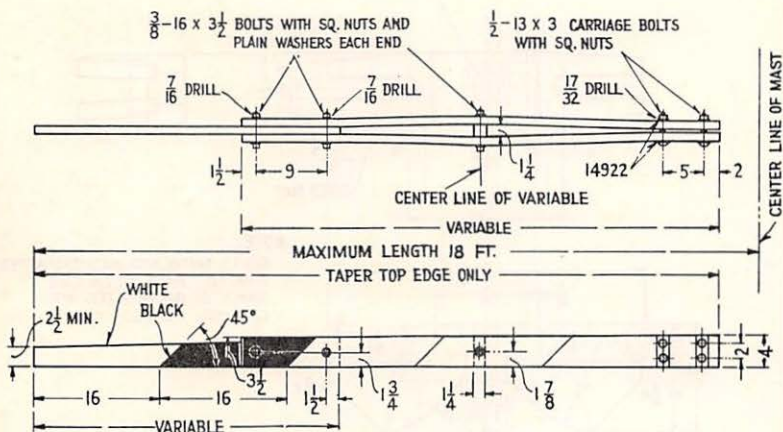
SEP. 1952 M-1951 SEP. 1951 M-1950 SEP. 1950 M-1947 SEP. 1947 M-1945 OCT. 1945 M-1943 OCT. 1943

AAR
SIG. SEC.
1489F

Bolts, nuts and threads shall be in accordance with Specifications for Bolts, Nuts and Threads, Manual Part 17; spring lock washers shall be of carbon steel (A.S.A. current Specification B27.1 is preferred, where practicable).



Bolts, nuts and threads shall be in accordance with Specifications for Bolts, Nuts and Threads, Manual Part 17; Spring lock washers shall be of carbon steel (A.S.A. current Specification B27.1 is preferred, where practicable); Painting shall be in accordance with Specification 120, Manual Part 110.

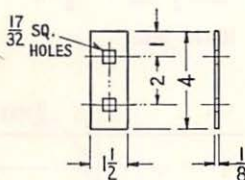
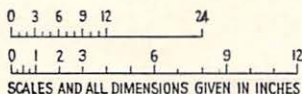


14921 CROSSING GATE SIDEWALK ARM, SPECIFY LENGTH.

NOTES:

LUMBER SHALL BE ONE INCH GRADE 'C' SELECT WHITE PINE OR EQUIVALENT DRESSED FOUR SIDES.

ALL BOLTS, NUTS AND PLAIN WASHERS SHALL BE GALVANIZED OR CADMIUM PLATED AFTER THREADS HAVE BEEN CUT.



14922 WASHER PLATE

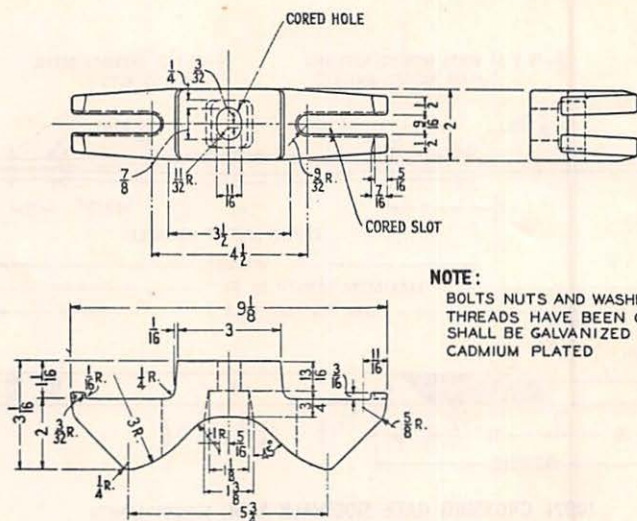
C1020 STEEL
GALVANIZED OR CADMIUM PLATED
4 REQ'D.

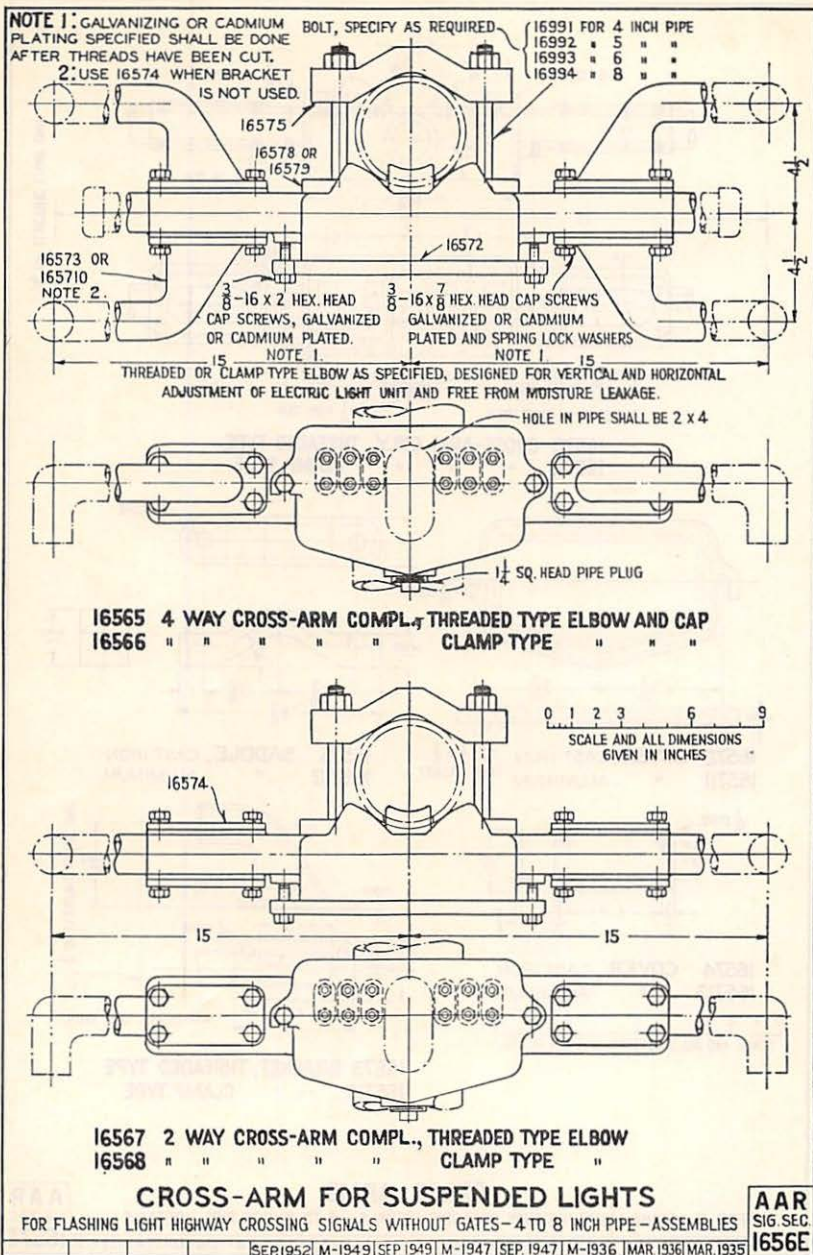
**HIGHWAY CROSSING GATE SIDEWALK ARM
FOR MAST MOUNTING**

A.A.R.
SIG. SEC.
14928

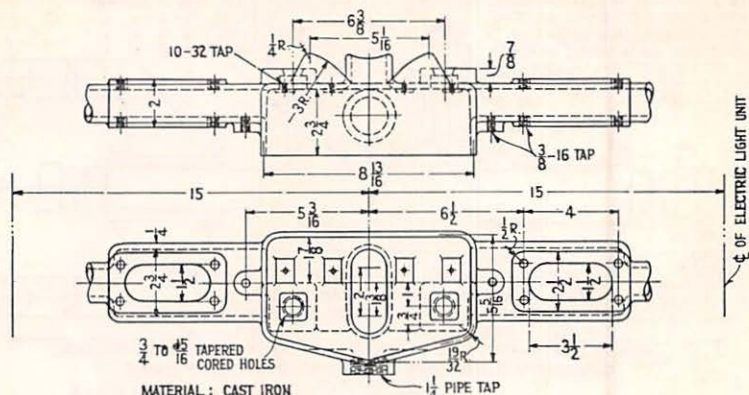
SEP. 1952 M-1949 SEP. 1949

Bolts, nuts and threads shall be in accordance with Specifications for Bolts, Nuts and Threads, Manual Part 17; Painting shall be in accordance with Specification 120, Manual Part 110.

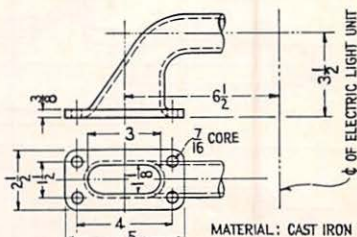
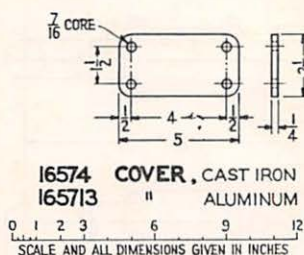
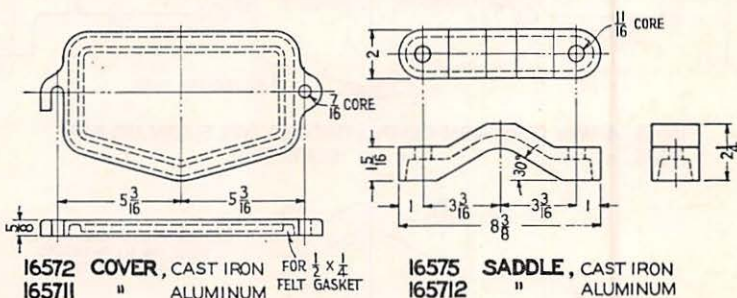




Bolts, nuts and threads shall be in accordance with Specifications for Bolts, Nuts and Threads, Manual Part 17. Spring lock washers shall be of carbon steel (A.S.A. current Specification B27.1 is preferred, where practicable).



16578 CROSS-ARM ONLY, THREADED TYPE
16579 " " " CLAMP TYPE



16573 BRACKET, THREADED TYPE
165710 " CLAMP TYPE

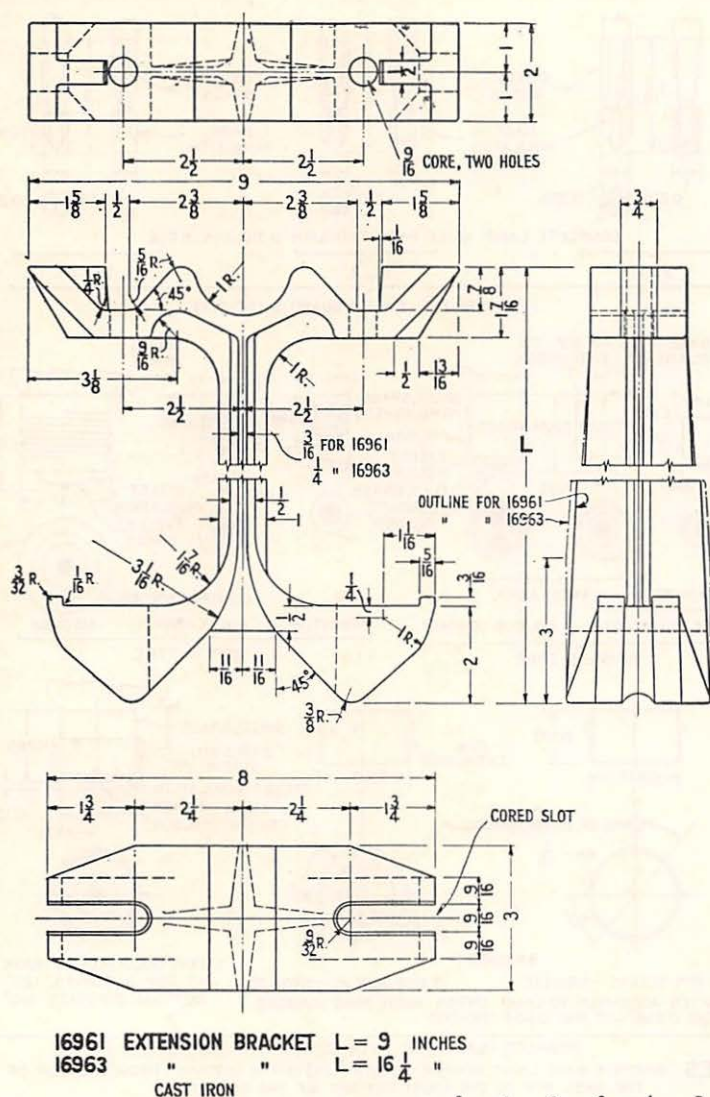
CROSS-ARMS

FOR FLASHING LIGHT HIGHWAY CROSSING SIGNALS—4 TO 8 INCH PIPE—DETAILS

SEP. 1952 | M-1949 | SEP. 1949 | M-1947 | SEP. 1947 | M-1936 | MAR. 1936 | MAR. 1935

A.A.R.
SIG. SEC.
1657E

Cast iron shall be Class 20 in accordance with Specification for Gray Iron Castings, Manual Part 88; Threads shall be in accordance with Specifications for Bolts, Nuts and Threads, Manual Part 17; Cast aluminum shall be A.S.T.M. No. B 26, alloy number and treatment as required; Aluminum parts shall be given an approved paint treatment after surfaces are treated to provide suitable paint adherence. When practicable, the surface treatment shall be approved corrosion-inhibiting type. Painting shall be in accordance with Specification 120, Manual Part 110.



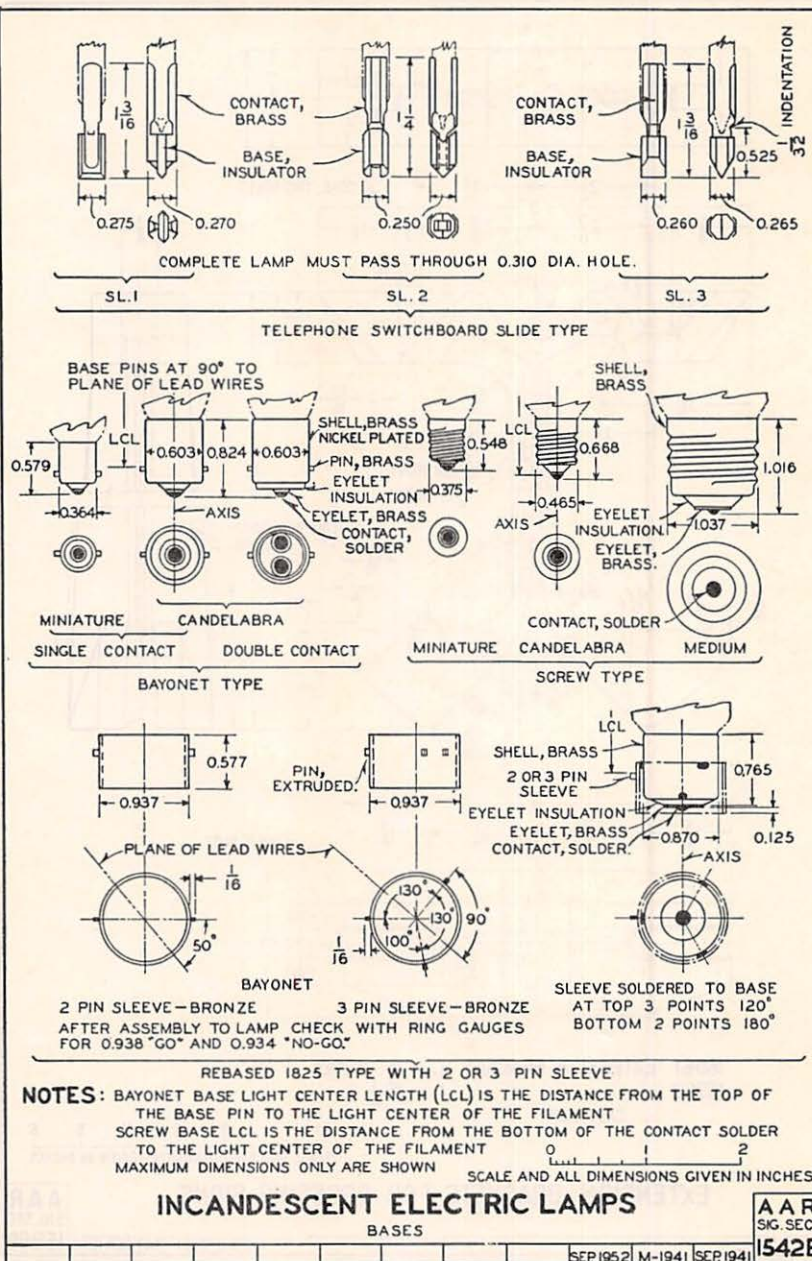
0 1 2 3 4 5 6
SCALE AND ALL DIMENSIONS GIVEN IN INCHES

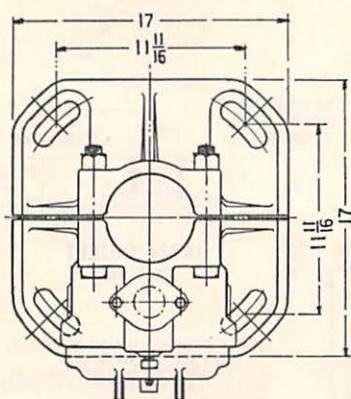
EXTENSION BRACKETS FOR CROSSING SIGNS

AAR
SIG.SEC
1696B

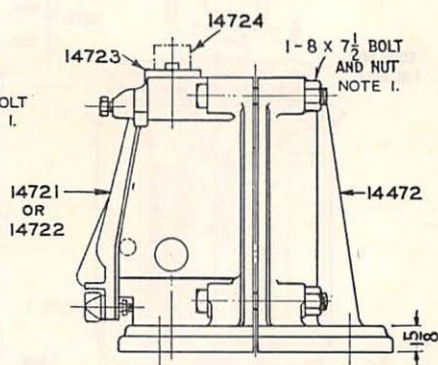
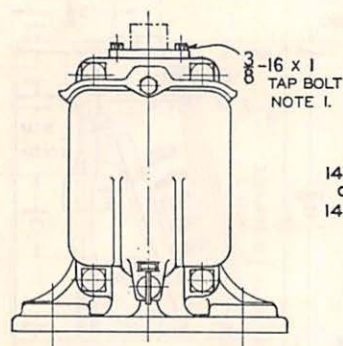
SEP 1952	M-1947	SEP. 1947
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Cast iron shall be in accordance with Specification for Gray Iron Castings, Manual Part 88;
Painting shall be in accordance with Specification 120, Manual Part 110.





NOTE 1. GALVANIZE OR CADMIUM PLATE
AFTER THREADS HAVE BEEN CUT.



14711	JUNCTION	BOX	CLAMP	BASE	COMPL.	WITH	14721	AND	14723
14712	"	"	"	"	"	"	"	"	14722
14713	"	"	"	"	"	"	"	"	14721
14714	"	"	"	"	"	"	"	"	14722

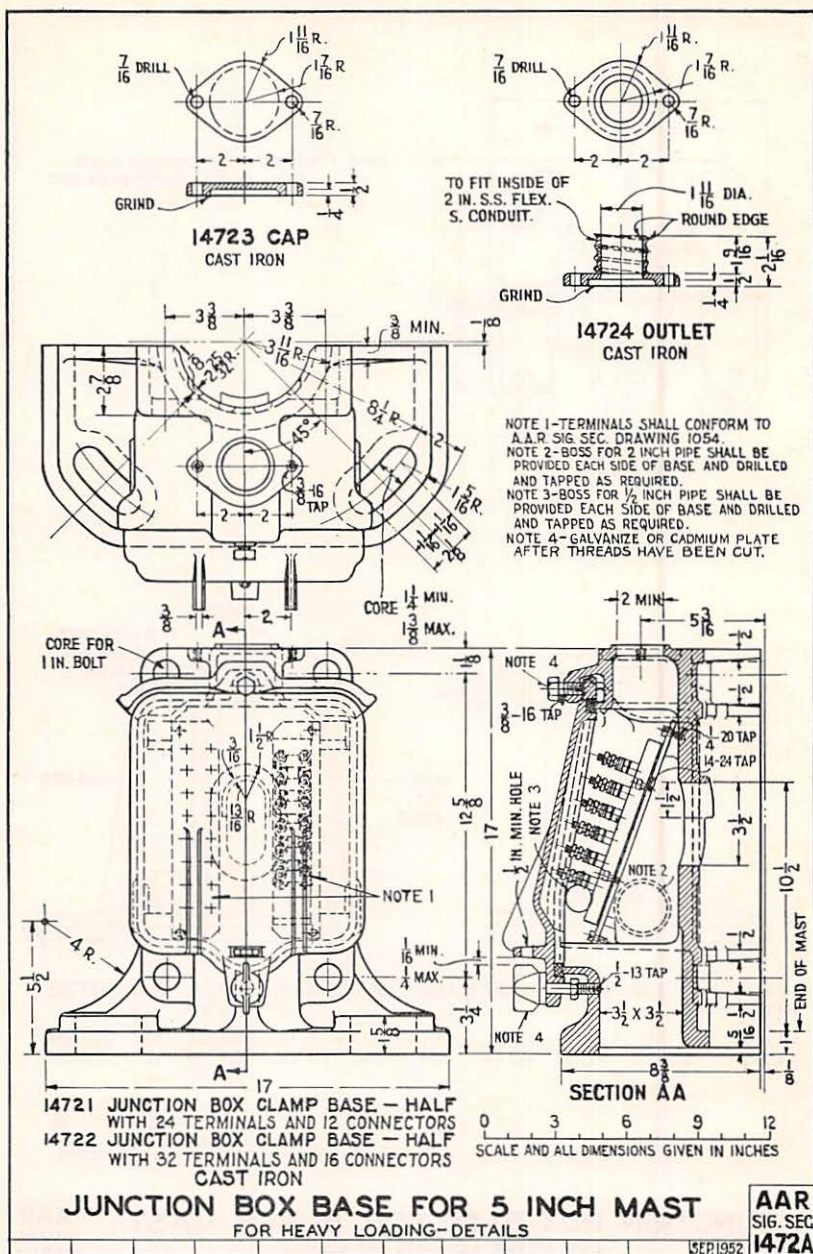
0 6 12 18
SCALE AND ALL DIMENSIONS GIVEN IN INCHES

JUNCTION BOX BASE FOR 5 INCH MAST
FOR HEAVY LOADING-ASSEMBLY

AAR
SIG. SEC.
1471 A

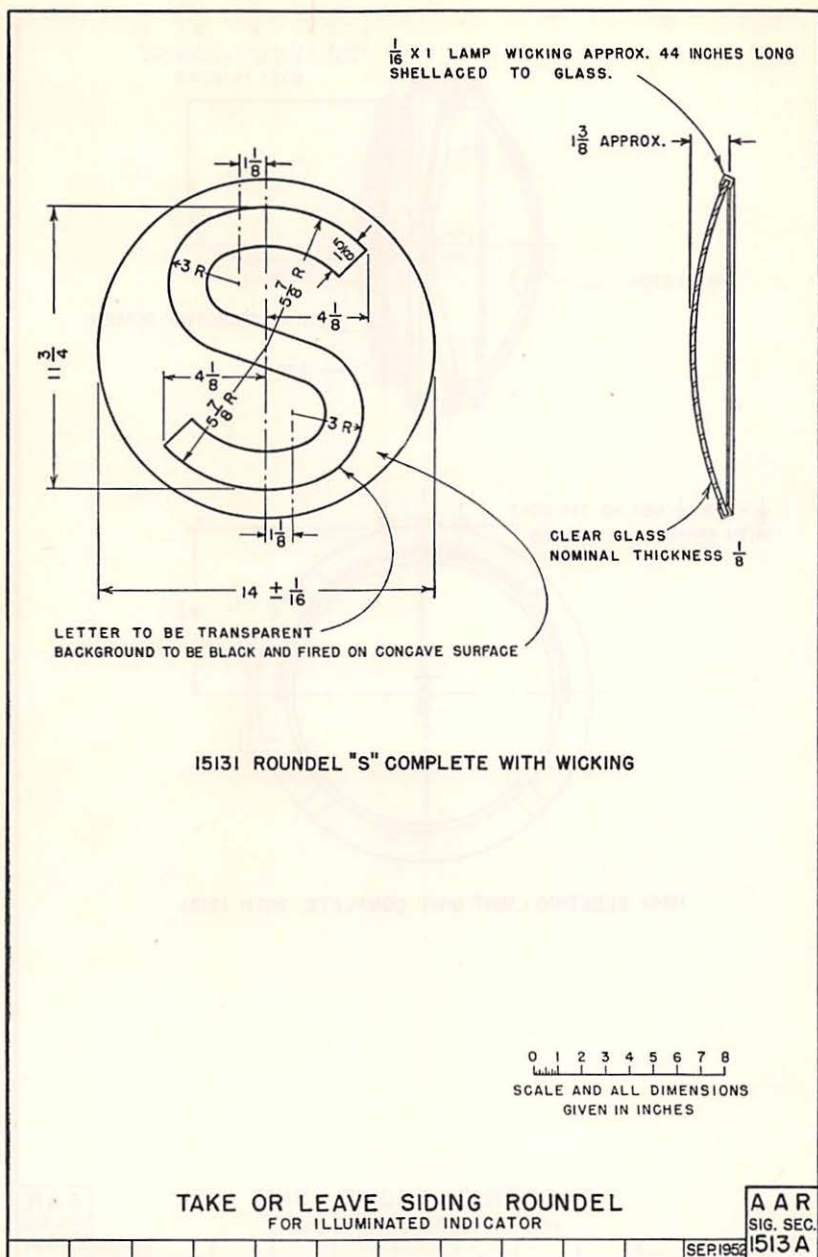
SEP 1952

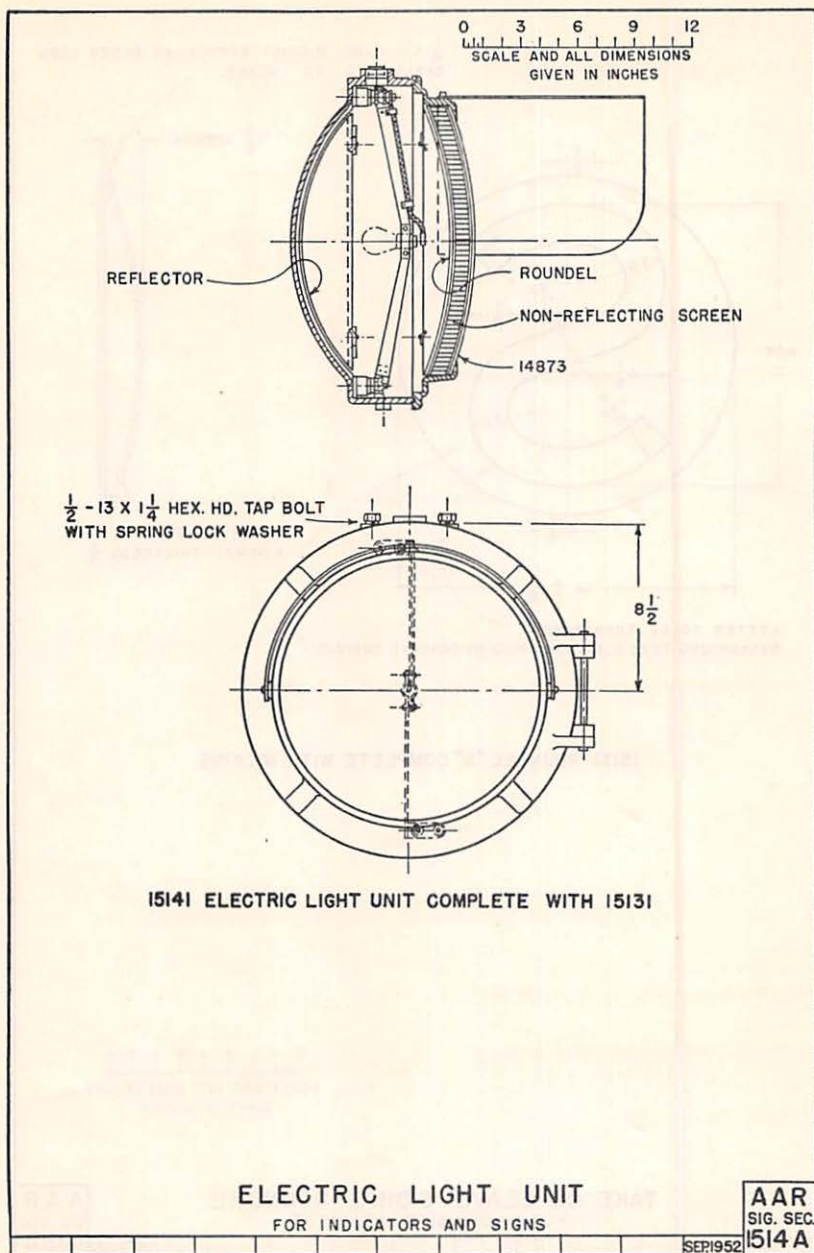
Bolts, nuts and threads shall be in accordance with Specifications for Bolts, Nuts and Threads,
Manual Part 17.



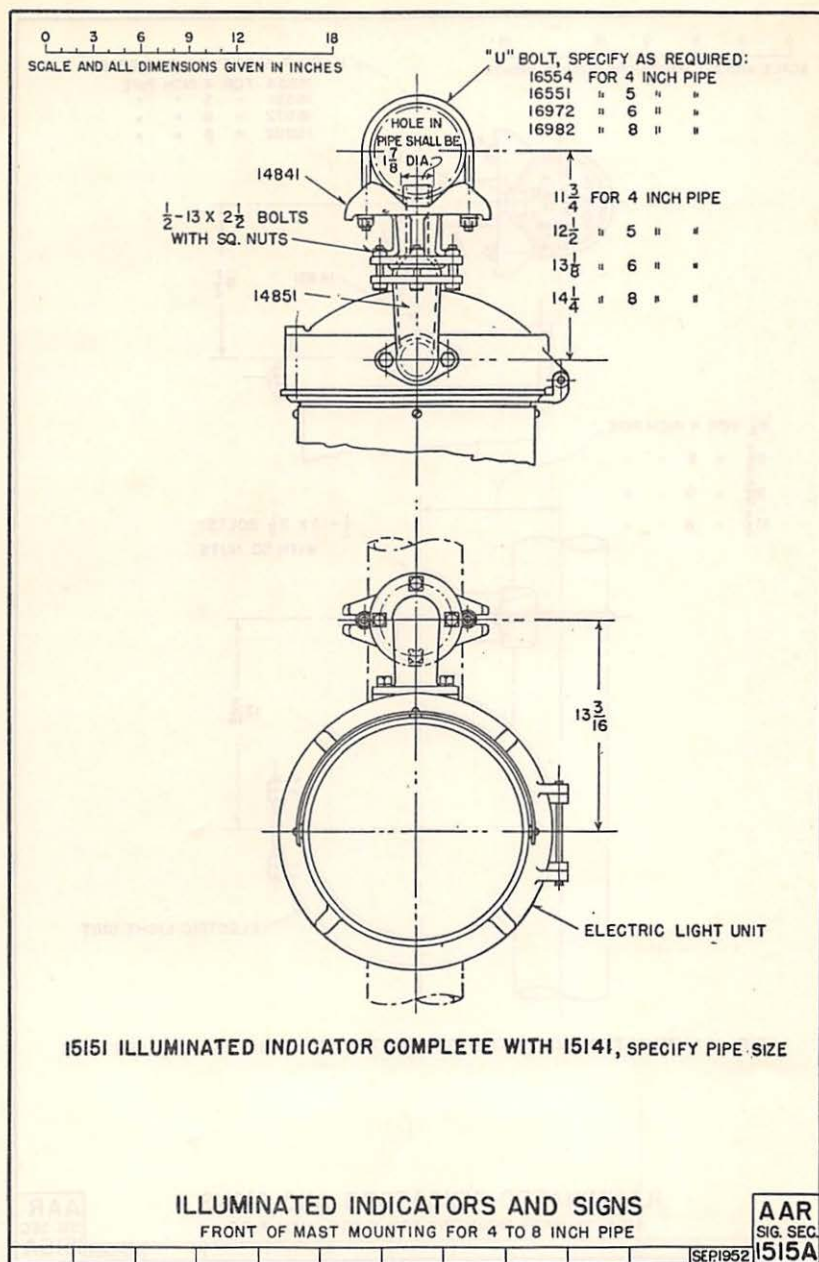
Cast iron shall be in accordance with Specification for Gray Iron Castings, Manual Part 88; Bolts, nuts and threads shall be in accordance with Specifications for Bolts, Nuts and Threads, Manual Part 17; Painting shall be in accordance with Specification 120, Manual Part 110.

Sept. 1952]

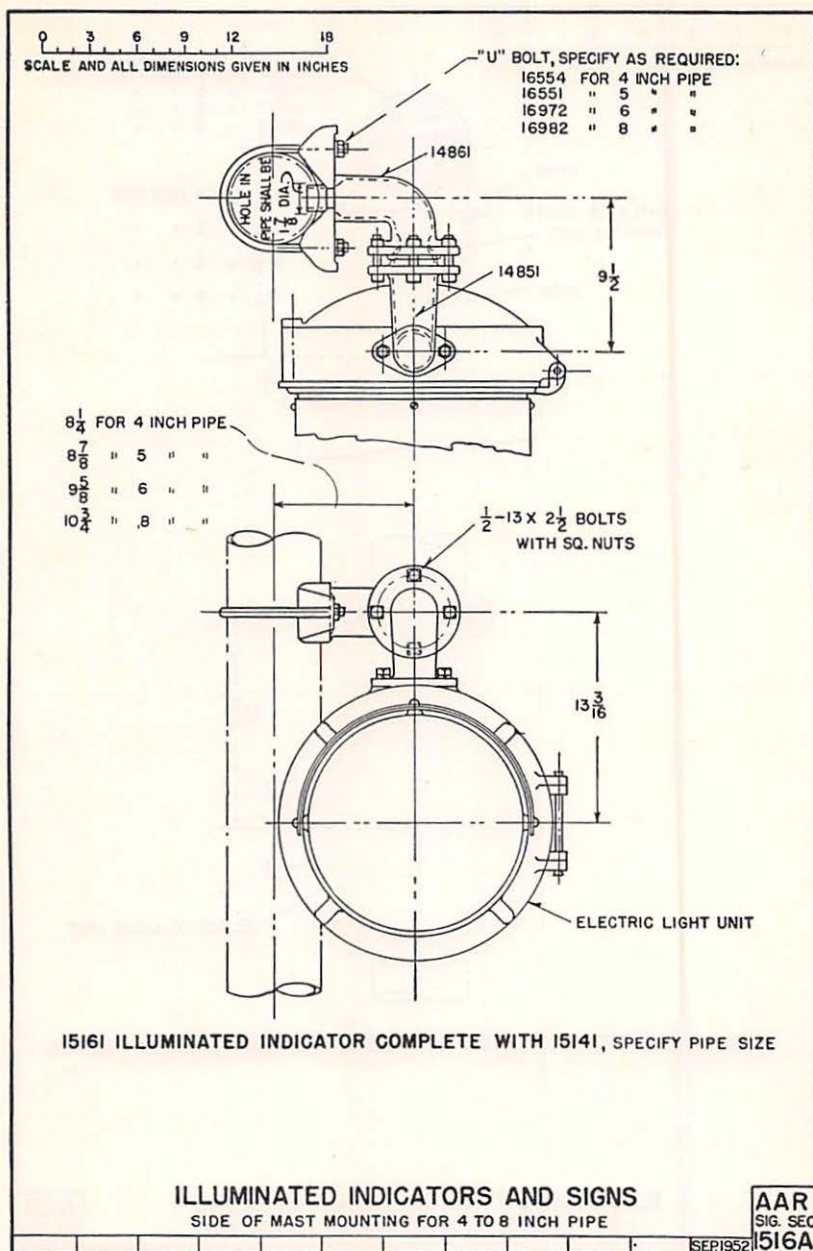




Unit shall be in accordance with Specification 231, Manual Part 237; Bolts, nuts and threads shall be in accordance with Specifications for Bolts, Nuts and Threads, Manual Part 17; Spring lock washers shall be of carbon steel (A.S.A. current Specification B27.1 is preferred, where practicable).



Indicator shall be in accordance with Specification 231, Manual Part 237; Bolts, nuts and threads shall be in accordance with Specifications for Bolts, Nuts and Threads, Manual Part 17.



Indicator shall be in accordance with Specification 231, Manual Part 237; Bolts, nuts and threads shall be in accordance with Specifications for Bolts, Nuts and Threads, Manual Part 17.

(Revision of A.A.R. Signal Section Specification 51-49)
A.A.R. SIGNAL SECTION SPECIFICATION 51-52.

INCANDESCENT ELECTRIC LAMPS

1. *Purpose.*

(a) This specification is for the purpose of providing for lamps generally required in railway signal lighting. It sets forth specific detail requirements representing modern signal practice recommended for new installations and for replacement on existing installations when general renewal or replacement becomes desirable.

(b) A list showing the activity rating of all lamps commonly used in signal practice is appended to this specification to encourage the elimination of lamps in the lower activity groups in the interest of standardization and simplification.

(c) This specification, so far as it refers exclusively to mechanical and physical characteristics, shall apply to all lamps purchased. The full provisions of this specification shall apply only to the lamps listed in the accompanying schedules of commercial ratings and tables of initial rating tolerances.

(d) The full provisions of this specification shall not apply to any inside frosted miniature lamps or to outside frosted, daylight or colored large or miniature lamps, or to lamps other than those with the usual clear or inside frosted bulbs, except that the wattage or ampere tolerances increased by 1 shall apply.

2. *Drawings and appendix.*

(a) Drawings and appendix referred to in the body of this specification form an essential part hereof.

(b) Manufacturer shall furnish with his tender, drawings forming an essential part thereof.

3. *Tender.*

(a) The tender shall be for a product meeting the requirements of this specification in its entirety.

4. *Purchaser's order requirements.*

(a) The following additional requirements will be shown on Purchaser's order:

1. Item number.
2. Supplier's ordering reference.
3. Inspection and tests as required.
4. Alternate requisites as required.

5. *Alternates.*

(a) The provisions contained in the alternate requisites section of this specification form a part hereof only when substituted by Purchaser's order for the provisions contained in this specification.

6. *Material and workmanship.*

(a) Material and workmanship shall be first-class in every respect.

7. *Definition and standards.*

(a) Large lamps designate broadly lamps regularly fitted with other than miniature bases. Miniature lamps designate broadly lamps designed for automotive, flashlight and similar types of service, and, in general, are equipped with bases smaller than those used in large lamps.

(b) Lamps shall conform to Drawings 1541, 1542 and 1543.

(c) Lamps shall conform to Appendix A.

(d) Electrical units referred to in this specification are the current International Units.

(e) Units of luminous intensity shall be the International Candle as maintained by the National Bureau of Standards, Washington, D. C.

(f) The basis of photometric measure for all lamps may be either the total flux expressed in lumens, or the equivalent mean spherical candlepower, which is the average candlepower of the lamp in all directions in space and equals the total luminous flux of the lamp divided by 12.57.

(g) The rating of lamps is expressed by volts together with either amperes, watts, candlepower or lumens.

(h) The life of the lamp is the rated average laboratory life in hours. In two filament lamps the burnout of either filament shall be considered as the end of life.

8. *Bulb and stem.*

(a) The material shall be lime or lead glass.

(b) Bulb shall be uniform in size and shape, clear, clean and free from flaws and blemishes detrimental to service.

9. *Base.*

(a) The material shall be good quality brass.

(b) Base shall be moisture-proof, the brass eyelet insulated from the base with glass, firmly and accurately fitted to the bulb with moisture-resisting cement.

10. *Filament.*

(a) The material shall be tungsten. *R-10-a.

* Alternate requisites section.

10. *Filament.*—Continued.

(b) Filament shall be free from imperfections detrimental to good service and shall be symmetrically disposed in the bulbs.

(c) The filament shall operate within an atmosphere of gas or within a vacuum. In either case the amount of air shall be as small as is obtainable with the best commercial practice.

11. *Leading-in wires.*

(a) The material shall be of good electrical conductivity and that portion imbedded in the glass shall have a coefficient of expansion as near that of the glass through which they pass as is practically possible.

(b) The wires shall be securely attached to the filament and to the base in such a manner that an electric circuit of good conductivity is permanently maintained.

12. *Identification.*

(a) Each lamp shall be plainly marked with rating and Manufacturer's name or trade-mark, on the bulb or base where space permits.

13. *Inspection.*

(a) The product furnished under this specification may be accepted upon Manufacturer's certificates of guarantee insuring that it is in accordance with the specification. If on arrival at destination the product is found not to meet the requirements of the specification it may be rejected and the Manufacturer, upon request, shall advise the Purchaser what disposition is to be made of the rejected product. Manufacturer shall pay all freight charges.

14. *Tests.*

(a) Tests may be made at point of production, or on samples submitted, and may also be made at destination.

(b) Manufacturer shall give the Purchaser sufficient notice of time when the material or product will be ready for testing.

(c) Manufacturer shall provide, at point of production, apparatus and labor for making required tests under supervision of the Purchaser.

(d) If tests are to be made at point of production, it shall be so stated on Purchaser's order. The Purchaser shall indicate which of the tests herein specified are to be made and what portion of the material or product shall be tested.

15. *Samples for test.*

(a) All lamps of any one type, size and voltage offered by the Manufacturer at any one time shall be known as a "lot."

15. *Samples for test.*—Continued.

(b) The number of lamps selected for physical and rating inspection and tests shall be not less than 5 per cent of the lot (minimum 10 large or 20 miniature), taken at random and proportionally from the individual packages of the lot.

(c) Test lamps used for rating test shall have been sufficiently burned (seasoned) to have reached stable values of watts and lumens (or candlepower) before the initial rating test is made.

16. *Acceptance requirements.*

(a) The finished lamps shall withstand successfully the performance tests and physical characteristics required by this specification and drawings referred to, which form an integral part of this specification.

(b) Physical defects.

1. Lamps shall not have minor defects that mar the appearance of the lamps or are otherwise incompatible with good workmanship or good service. A lot may be rejected without further test if 10 per cent plus 1 lamp (20 per cent plus 1 lamp when tested elsewhere than at the factory) or more of the test lamps have such defects.

2. Lamps shall not have major defects which would render lamps inoperative or which would cause them unquestionably to give poor service. A lot of large lamps may be rejected without further test if 1 per cent plus 1 lamp (2 per cent plus 2 lamps when tested elsewhere than at the factory) or more of the test lamps have such defects. A lot of miniature lamps may be rejected without further test if 1 per cent plus 2 lamps (2 per cent plus 3 lamps when tested elsewhere than at the factory) or more of the test lamps have such defects. Individual lamps having major physical defects may be rejected and eliminated from the lot.

(c) Manufacturer's declared efficiency.

1. The Manufacturer shall declare for each lot of lamps furnished under these specifications, the initial efficiency at which the lamps are to be appraised for compliance with rating and life requirements. The declared efficiency shall be not more than 2 per cent below the lumens-per-watt (large lamps), nor more than 4 per cent above the candles-per-watt (miniature lamps) value shown in Tables VII and VIII, Schedule of Commercial Ratings. For the purpose of maintaining the rated life given in the schedule, the efficiency of any size of lamp may be changed by notice from the Manufacturer, provided the preceding stipulation is complied with.

(d) Rejection for spread in rating.

1. Test lamps shall be operated at rated volts or amperes. A lot of lamps may be rejected if 20 per cent plus 2 lamps (30 per cent plus 2 lamps when tested elsewhere than

16. *Acceptance requirements.*—Continued.

at the factory) or more of the test lamps depart from the Manufacturer's declared initial rating by more than the tolerance specified in Tables V and VI, Initial Rating Tolerances. Individual test lamps may be rejected and eliminated from an accepted lot if they fall outside these tolerances by more than an additional 4 per cent for large and 8 per cent for miniature lamps.

(e) Life performance test.

1. Selection and quantities.

(a) Lamps for life performance test shall be selected from and be representative of the test lamps. They shall be selected in not less than the following ratios:

1. Large lamps: 4 from the first 1,000 and 1 from each 500 (or part) beyond 1,000 (minimum 5 lamps).

2. Miniature lamps: 8 from the first 1,000 and 2 from each 500 (or part) beyond 1,000 (minimum 10 lamps).

2. Life test voltages or currents.

(a) Lamps shall be operated on the test racks at design volts or at voltages corresponding either to the Manufacturer's declared efficiency (subject to the provisions of section 16-c-1), or to an efficiency or voltage mutually agreed upon. Operation at approximately the voltages indicated is sanctioned, provided proper life adjustments are made.

3. Position of burning.

(a) Lamps designed for a particular burning position shall be so tested. All other lamps shall be tested in the position in which they are most generally used in service.

4. Voltage regulation.

(a) Accurate recording meter records shall be obtained throughout the tests to show the variation of the circuit voltage. Variations of voltage shall not exceed one-half of 1 per cent above or below the test voltage on miniature lamps or one-fourth of 1 per cent on large lamps.

5. Rejection.

(a) Any lot of lamps, provided that such lot is represented on test by at least the minimum required number of lamps in accordance with section 16-e-1-a may be rejected if the average hours' life of the test lamps when computed to the Manufacturer's declared initial efficiency rating falls below the life value specified in

16. *Acceptance requirements.*—Continued.

Tables VII and VIII, Schedules of Commercial Ratings, by more than the life tolerance specified in the following tables* for the number of test lamps averaged.

TABLE I
Life Tolerances (Large Lamps)

Number of lamps averaged	Allowable per cent variation	Number of lamps averaged	Allowable per cent variation	Number of lamps averaged	Allowable per cent variation
250 and above	5	24-20	12	9	19
249 to 100	6	19-18	13	8	20
99 to 55	7	17-16	14	7	21
54 to 45	8	15-14	15	6	23
44 to 35	9	13-12	16	5	25
34 to 30	10	11	17		
29 to 25	11	10	18		

TABLE II
Life Tolerances (Miniature Lamps)

Number of lamps averaged	Allowable per cent variation from rated life
100 and above	15
40-99	16
20-39	17
10-19	18

The life tolerance for any type of lamp is determined by multiplying the allowable per cent variation in Table II by the "multiplying factor" for the particular lamp, as given in Tables V and VI, Initial Rating Tolerances.

(f) Determination of efficiency (lumens or candlepower) maintenance.

1. Large.

(a) Test lamps shall be measured at test volts (or amperes) for lumens-per-watt (or lumens) after an interval equivalent to 70 per cent of the rated life of the lamps. (If lamps are tested at Manufacturer's declared initial lumens-per-watt, the interval will be exactly 70 per cent of the rated life; if tested at some other agreed upon lumens-per-watt or at labeled volts (or amperes) an equivalent interval shall be computed for each lamp.)

* On account of the natural and inherent variations in individual lamp performance, the average test results of a small number of test lamps cannot be depended upon to indicate exactly the average for the larger quantity from which the test lamps were taken. The allowable variations shown in Tables I-VI are devised in accordance with the observed accuracy of lamp-testing methods and the observed variations in lamp performance.

16. *Acceptance requirements.*—Continued.

2. Miniature.

(a) Test lamps shall be measured for spherical candlepower at their design volts, both initially and at the expiration of four-fifths of the rated life. The measure of candlepower maintenance for an individual lamp shall be its spherical candlepower at four-fifths of the rated life, expressed as a percentage of its initial spherical candlepower.

3. Rejection.

(a) Large lamps for multiple circuits. Any lot of lamps may be rejected provided such lot is represented on test by the minimum required number of lamps in accordance with section 16-e-1-a-1 if the average lumens-per-watt at the 70 per cent interval determined in accordance with section 16-f-1-a falls below the value specified in Table VIII, Schedule of Commercial Ratings, by more than the tolerance specified in Table III. (If lamps are tested at other than the Manufacturer's declared initial lumens-per-watt, the lumens-per-watt at the 70 per cent interval shall be corrected by multiplying by the ratio of declared lumens-per-watt to initial test lumens-per-watt.)

(b) Miniature lamps, when tested in accordance with the foregoing test specifications. Any lot of lamps may be rejected, provided such lot is represented on life performance test by the minimum required number of lamps in accordance with section 16-e-1-a-2, and provided the per cent spherical candlepower at four-fifths rated life, as derived in accordance with section 16-f-2-a, falls below the per cent specified in Table VII, Schedule of Commercial Ratings, by more than the tolerance specified in Table IV.

TABLE III
Maintenance Tolerances (Large Lamps)

Number of lamps tested	Allowable per cent variation
100 and above	1
99-25	2
24-10	3
9-5	4

16. *Acceptance requirements.*—Continued.TABLE IV
Candlepower Maintenance Tolerances (Miniature Lamps)

Number of lamps tested	Allowable variation in candlepower at four-fifths rated life in per cent of average initial candlepower
100 and above	2
40-99	4
20-39	6
10-19	8

TABLE V
Initial Rating Tolerances (Miniature Lamps)

Lamp designation Trade No.	Base	Rated spherical candlepower	Circuit volts	Bulb	Initial rating tolerances at design volts			
					Variation in candles per watt, plus or minus	Variation in spherical candle- power, plus or minus	Variation in amperes, plus or minus	Multiplying factor for basic life tolerances
					Per cent	Per cent	Per cent	
67	SC	3	12-16	G-6	12	15	8	2.0
68	DC	3	12-16	G-6	12	15	8	2.0
87	SC	15	6-8	S-8	7	9	5	1.0
89	SC	6	12-16	G-6	12	15	8	1.5
1141	SC	21	12-16	S-8	9	10	6	1.0
63K	S. Can.	*3	6-8	G-6	6	8	5	1.5
67K	S. Can.	*3	12-16	G-6	12	15	8	2.0

* The candlepower is nominal.

TABLE VI
Initial Rating Tolerances (Large Lamps)

Watts	Volts	Bulb	Base	Initial rating tolerances at rated voltage	
				Lumens-per-watt above or below declared rating	Total watts above or below rating
9	12	G-16½	2 pin sleeve	12	7
11	11	S-11	Bayonet Candel.	12	7
18	10	A-15	2 or 3 pin sleeve	10	7

16 Acceptance requirements.—Continued.

TABLE VII

Schedule of Commercial Ratings (Miniature Lamps)

Trade No.	Base	Circuit, volts	Design, amperes	Rated spherical candle-power	Bulb	Maximum over-all length, inches	Light center length, inches	Design, volts	Candle-power maintenance at 4/5 life*, % of initial	Initial candles (spherical), per watt	Rated average laboratory life, hours
67	Bayonet Candel. SC	12-16	0.36	3	C-6	$1\frac{7}{16}$	$1\frac{3}{16}$	13.00	84	0.64	1,000
68	Bayonet Candel. DC	12-16	0.36	3	C-6	$1\frac{7}{16}$	$1\frac{3}{16}$	13.00	84	0.64	1,000
87	Bayonet Candel. SC	6-8	1.91	15	S-8	2	$1\frac{1}{8}$	6.75	90	1.16	300
89	Bayonet Candel. SC	12-16	0.58	6	G-6	$1\frac{7}{16}$	$\frac{3}{4}$	13.00	82	0.80	750
1141	Bayonet Candel. SC	12-16	1.36	21	S-8	2	$1\frac{1}{4}$	12.80	82	1.20	500
63K	S. Can.	6-8	0.63	†3	G-6	$1\frac{3}{8}$	$1\frac{5}{16}$	7.00	91	0.74	1,000
67K	S. Can.	12-16	0.36	†3	G-6	$1\frac{3}{8}$	$1\frac{5}{16}$	13.00	83	0.71	1,000

* These maintenance values apply to base horizontal burning.

† The candlepower is nominal.

16. Acceptance requirements.—Continued.

TABLE VIII
Schedule of Commercial Ratings (Large Lamps)

Watts	Volts	Bulb	Base	Initial lumens	Initial lumens-per-watt	Rated average life (hours)†	Filament	Light center length, inches	Maximum over-all length, inches	Position of burning
9	12	G-16½	2 pin sleeve	95	10.5	1,500	C-2R	*1.91	3	Any
11	11	S-11	Bayonet Candel.	104	9.5	2,500	C-2V	1¼	2⅜	Any
18	10	A-15	2 or 3 pin sleeve	207	11.5	1,500	C-2V	2⅛ ₃₂ or 2⅜ ₁₆	3¾	Any

* Measured to top of filament.

† Life under specified test conditions.

17. *Packing.*

(a) Product shall be so assembled or packed as to permit convenient handling and to protect against loss or damage during shipment.

18. *Marking.*

(a) Purchaser's order, requisition and package number, name of Consignor, and name and address of Consignee, shall be plainly marked on outside of packages and on tags attached to loose pieces.

(b) Detail list of loose pieces, packages and their contents shall be furnished for each shipment. Where carload shipments are made, routing and car identification shall be shown.

Alternate requisites.

R-10-a.

The material shall be.....

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Specification 51-49—Incandescent Electric Lamps, Manual Part 91.

APPENDIX A

SIMPLIFICATION AND STANDARDIZATION OF INCANDESCENT
ELECTRIC LAMPS FOR RAILROAD SIGNAL PURPOSES

This list has been compiled to encourage the use of lamps in the more active group ratings, and the elimination as far as practicable of those in the lower activity groups.

ACTIVITY GROUP BASED ON PERIOD 1949-1952, SPECIAL TYPES.

	No. of items
A 10,000 or more lamps sold per year	11
B 1,000 to 10,000 " " " "	35
C 100 to 1,000 " " " "	28
D 1 to 100 " " " "	8
X No " " " "	0

82 Total

Note.—Lamps in the COMMERCIAL group not included in above total.

Symbols, Abbreviations and Notes Pertaining to Activity Group Tables

TYPES:

Special—Lamps designed for signal use

Commercial—Lamps designed primarily for services other than signaling

SOURCE:

W—Westinghouse Electric Corp., Lamp Division

G—General Electric Co., Lamp Department

GRS—General Railway Signal Co.

US&S—Union Switch & Signal Div. of Westinghouse Air Brake Co.

WE—Western Electric Co.

PC. No.—Piece Number

Dwg. No.—Drawing Number

ELECTRICAL:

A—Amperes

W—Watts

CP—Spherical Candlepower

BULB:

Shape—Drawing 1541

Color—Clear unless otherwise noted

Class—Type C (Gas filled unless otherwise noted)

*—Type B (Vacuum)

BASE (Drawing 1542):

B.MIN—Bayonet miniature, single contact

SC—Bayonet candelabra, single contact

DC—Bayonet candelabra, double contact

BASE (Drawing 1542)—Continued:

- S.MIN—Screw miniature
- S.CAN—Screw candelabra
- S.MED—Screw medium
- 2-PS—Rebased with 2 pin sleeve (US&S)
- 3-PS—Rebased with 3 pin sleeve (GRS)
- 1825—Used with 2 and 3 pin sleeve
- SL.1—Slide telephone switchboard (902, W-G-GRS)
- SL.2—Slide telephone switchboard (WE)
- SL.3—Slide telephone switchboard (905, G-US&S)

FILAMENT:

- MF—Major filament
- SF—Secondary filament
- Shape—Drawing 1543
- INV.—Inverted
- LCL—Light center length in inches
- Tolerance—Plus-minus dimensions in inches allowed on LCL and AA (axial alignment). Where two dimensions are shown the first applies to LCL and the second to AA. Where no tolerance is shown, Manufacturer's standard to apply
- Material—Tungsten unless otherwise noted

LIFE HOURS:

Manufacturer's laboratory rated average burning hours of a group of lamps tested under specified test conditions

MANUFACTURERS' DESIGNATION:

- RLS—Railroad light signal, visible day and night indication
- RS—Railroad signal, visible night indication only
- Manufacturers' ordering abbreviation or number shown for commercial type lamps

RAILROAD USE:

- SEM—Semaphore signal
- CLT—Color light signal
- PLT—Position light signal
- CPLT—Color position light signal
- SLT—Searchlight signal
- TO—Train order signal
- XNG—Highway crossing signal
- IND—Indicator
- LL—Lever light
- CTI—Chart track indicator (includes C.T.C.-NX-UR)
- SL—Switch lamp
- CGA—Crossing gate arm

Note.—Tables are revised triennially and lamps shown in the X group removed. Current X group lamps have been delisted by the Manufacturers and discontinued.

ACTIVITY GROUP TABLE INCANDESCENT ELECTRIC LAMPS FOR RAILROAD SIGNAL PURPOSES—SPECIAL TYPES

Activity group	Item No.	Mfr. desig.	Source			Amps. Watts CP	Volts	Bulb	Base	Filament				Life hours	Railroad use	Principal railroads using
			GRS Dwg. No.	W-G	US&S PC.No.					Shape		LCL	Tolerance			
										MF	SF					
C	1	RLS	47438-9GR5	W-G		10W	8	A-15	3-PS	A-Bulb						GN
B	2	RLS		W-G	144539	10W	8	A-15	2-PS	C-2R		23/16	1/64	1,000	CLT	Clin-L&N-MKT
D	3	RLS		W-G	189826	10W 13.5W	8	A-15	2-PS	C-2V		27/32	1/64	1,500	CLT-XNG	WM
C	4	RLS	47438-9GR4	W-G		18W	8	A-15	3-PS	C-2R	C-2V-INV	27/32	1/64	1,500	CLT	B&O-D&RGW-GN-MP-NYC-NP-T&P
B	5	RLS		W-G	144541	18W	8	A-15	2-PS	C-2V		27/32	1/64	1,500	CLT	MKT-UP
C	6	RLS	47438-6GR2	W-G		18W	8	A-15	3-PS	2C-2V		27/32	1/64	1,500	CLT	FEC-GM&O-PRR
C	7	RLS		W-G	184972	18W 13.5W	8	A-15	2-PS	C-2V	C-2V-INV	27/32	1/64	1,500	CLT	CMS&P&C-CRI&P-L&N-NC&StL-SP-UP
B	8	RLS	47438-22GR1	W-G		18W 13.5W	8	A-15	3-PS	C-2V	C-2V-INV	27/32	1/64	1,500	CLT	C&N&W-CRI&P-GM&O-NC&StL-T&P
B	9	RLS	47438-23GR1	W-G		40W	8	A-15	3-PS	C-2V		27/32	1/64	3,000	CLT-SEM	NYNH&H
B	10	RLS		W-G	135247	10W	10	A-15	2-PS	C-2V		27/32	1/64	1,500	CLT	CGW-CRI&P-S&L-T&NO-UP
D	11	RLS	47438-9GR2	W-G		10W	10	A-15	3-PS	C-2R		27/32	1/64	1,500	CLT	C&S&P&M&O-DM&IR-FEC
B	12	RLS	47438-0GR3	W-G		18W	10	A-15	3-PS	2C-2V		27/32	1/64	1,500	CLT*	KCS-L&N-MP-NYC&StL-N&W-T&P-Wab
B	13	RLS	47438-20GR1	W-G		18W 13.5W	10	A-15	3-PS	C-2V	CC-6	27/16	1/64	1,500	CLT	B&M-CGW-CRI&P-GM&O-NC&StL-NYC-Sou
B	14	RLS	47438-9GR6	W-G		18W	10	A-15	3-PS	C-2R		27/16	1/64	1,500	CLT	C&N&W-D&RGW-FEC-GM&O-NYC-Sou-T&P
A	15	RLS		W-G	142944	18W	10	A-15	2-PS	C-2V		27/16	1/64	1,500	CLT-XNG	CNJ-CRI&P-DL&W-Erie-NYC-NYC&StL-NYNH&H-N&W-UP-Wab
A	16	RLS		W-G	214227	18W 13.5W	10	A-15	2-PS	C-2V	CC-6	27/16	1/64	1,500	CLT-XNG	AT&SF-ACL-C&O-CMS&P&P-CRI&P-IC-L&N-NYNH&H-PRR-S&L-UP
B	17	RLS		W-G	144543	30W	10	A-15	2-PS	C-2V		27/16	1/64	1,500	CLT-XNG	A&S-CRI&P-DL&W-Erie-NYC&StL-PRR-UP
B	18	RLS		W-G	189825	30W 16W	10	A-15	2-PS	C-2V	CC-6	27/16	1/64	1,500	CLT-XNG	AT&SF-C&O-CRI&P-Erie-NC&StL-PRR-S&L-S&F-S&L
B	19	RLS		W-G	144545	40W	10	A-15	2-PS	C-2V		27/16	1/64	1,500	CLT	CNJ-L&N-NC&StL-NYNH&H-N&W-Rdg
B	20	RLS	47438-15GR1	W-G		40W	10	A-15	3-PS	C-2V		27/16	1/64	1,500	CLT	B&O-CRI&P-NYC-NYNH&H
D	21	RLS	47438-0GR1	W-G		40W	10	A-15	3-PS	2C-2V		27/16	1/64	1,500	CLT	D&RGW-P&WV-StL-S&F-T&P
B	22	RLS	47438-21GR1	W-G		40W 13.5W	10	A-15	3-PS	C-2V	C-2V-INV	27/16	1/64	1,500	CLT	GSF-NC&StL-Rdg
C	23	RLS		W-G	120620	36W	30	A-15	2-PS	2C-2V		27/16	1/64	1,500	CLT-XNG	AT&SF-C&IM-N&W
D	24	RLS	47438-0GR4	W-G		36W	30	A-15	3-PS	2C-2V		27/16	1/64	1,500	CLT	C&IM
C	25	RLS	47438-12GR1	W-G		30W	120	A-15*	3-PS	C-5		27/16	1/64	1,500	CLT	B&O-B&M-CRI&P-GN-MP
C	26	RLS		W-G	144551	30W	120	A-15*	2-PS	C-5		27/16	1/64	1,500	CLT	B&M-CP-CM&P&P-LI-WofA
A	27	RLS		W-G	215005	9W	12	CT-7	SC	CT-Bulb		1 1/4	1/64	1,500	PLT	B&O-NYC&StL-PRR-Rdg-Wab
C	28	RS	43198-7	W-G		0.20A	14	G-6*	S.Min	C-2V		7/8		1,000	IND-LL-CTI	AT&SF-B&O-Erie-GTW-LV
B	29	RS		W-G	75679	1.25W	12	G-8*	S.Can	C-2V		1		1,000	IND-LL-CTI	ACL-B&O-C&O-Erie-NYC-NYNH&H-RF&P
C	30	RLS		W-G	221241	29W 16.5W	8	G-16 1/2	xSC	C-2R	CC-6	1 5/8	1/64	3,000	CLT	AT&SF-CMS&P&P
C	31	RLS		W-G		40W	6	G-16 1/2	S.Med	C-2V		1 3/4		1,000	SEM	NYNH&H

x Special.

† LCL measured to top of filament.

ACTIVITY GROUP TABLE INCANDESCENT ELECTRIC LAMPS FOR RAILROAD SIGNAL PURPOSES—SPECIAL TYPES

Activity group	Item No.	Mfr. desg.	Source			Amps. Watts CP	Volts	Bulb.	Base	Filament				Life hours	Railroad use	Principal railroads using
			GRS Dwg. No.	W-G	US&S PC. No.					Shape		LCL	Tolerance			
										MF	SF					
A	32	RLS	34866-69	W-G	220601	40W	10	G-16 1/2	SC	G-Bulb (Contd.)	CC-6 C-2R	1 1/4 †1.91	1 1/4 1/4	1,000	CLT-XNG	L&H-PRR-Rdg-StLSF-SAL-SP B&O-C&O-CMStP&P-LV-L&N-NYC-NYC&StL-N&W-PRR-Wab B&M-EJ&E-DM&IR-KCT C&NW-CB&Q-FEC-NP A&S-C&WI
C	33	RLS	47438-14GR1	W-G	152591	9W	12	G-16 1/2	2-PS					1,500	PLT	
B	34	RLS	34866-45	W-G		25W	120	G-16 1/2 *	SC	CC-11 C-5 2C-2V S-Bulb	CC-11 C-5 2C-2V	1 1/4 1 1/4 2 1/8	1/4 1/4 1/4	1,000	CLT-SLT	DT&I-Erie-StLSF-PRR CB&Q AT&SF-B&O-B&M-CGW-CMStP&P-CRI&P-KCS-L&N-NYC-SAL-Sou-WM AT&SF-ACL-CB&Q-CMSP&P-CRI&P-IC-L&N-MKT-NYC-UP CMSP&P-CRI&P-T&NO SP CN-CRI&P-GM&O-L&N-NYC-NP-PRR-T&NO-T&P-WP-UP NYC B&M-D&H-DM&IR-FEC-NYC-PRR-StLSF-T&NO-T&P-Wab NP AT&SF-ACL-B&O-C&O-CB&Q-CGW-CMSP&P-CRI&P-EJ&E-Erie-LV-L&N-MRy&TCo-NP-SAL-UP MKT CGW-CMSP&P-NYC-N&W-Wab-WofA AT&SF-B&M-IC-LV-MP-PRR-Sou AT&SF-IC-SP DM&IR AT&SF-ACL-CMSP&P-CRI&P ACL-CP-CMSP&P-CRI&P-DM&IR-PRR-Rdg C&NW-L&N-T&P CLT-SGW-IC-MKT-NYC&StL-SP AT&SF-C&NW-CMSP&P-Erie-PRR-Rdg-SAL-SP-T&P D&RGW-DM&IR-GM&O-T&P C&NW-CRI&P-MKT-SP AT&SF-CMSP&P-D&RGW-NC&StL-StLSF-SOU T&P
C	35	RLS	34866-46	W-G	135893	25W	120	G-16 1/2 *	SC					1,000	CLT	
B	36	RLS		W-G	112968	36W	30	G-18 1/2	S. Med					1,500	CLT	
B	37	RS	34866-65	W-G	188498	0.15A	2.5	S-8 *	SC	C-2R	C-2R	1 1/4 1 1/4 1 1/4	1/4 1/4 1/4	1,000	SEM-SLT	SEM-SLT SEM-CLT-SLT
C	38	RS		W-G		0.15A	2.7	S-8 *	SC					1,000	SL	
B	39	RS	34866-56	W-G	172274	0.12A	3.5	S-8 *	SC					1,000	SEM-CLT-SLT	
B	40	RS	34866-2	W-G	120799	0.3A	3.5	S-8 *	SC	C-2R	C-2R	1 1/4 1 1/4	1/4 1/4	1,000	SEM-SLT-CGA	SEM-SLT-CGA
B	41	RS	34866-3	W-G	120800	0.25A	8	S-8 *	SC					1,000	SEM	
C	42	RS		W-G	208573	0.25A	10	S-8 *	DC	C-2R	C-2R	1 1/4 1 1/4	1/4 1/4	1,000	SEM	SEM
B	43	RS	34866-4	W-G	120801	0.25A	10	S-8 *	SC					1,000	SEM	
C	44	RS		W-G		0.12A	12	S-8 *	SC	C-2V	C-2R	1 1/4 1 1/4	1/4 1/4	1,000	SEM	SEM
B	45	RS	34866-5	W-G	120802	0.25A	12	S-8 *	SC					1,000	SEM-CLT	
C	46	RS	34866-73	W-G		0.12A	13.5	S-8 *	SC	C-2V	C-2R	1 1/4 1 1/4	1/4 1/4	1,000	SEM	SEM
A	47	RS	34866-6	W-G	120803	0.25A	13.5	S-8 *	SC					1,000	SEM-XNG	
C	48	RS		W-G	124019	0.25A	13.5	S-8 *	DC	C-2R	C-7A	1 1/4 1 1/4	1/4 1/4	1,000	SEM	SEM
C	49	RS		W-G	176725	10W	120	S-8 *	SC					1,500	SEM-XNG	
C	50		48389			2CP	125	S-8 *	S. Min	Carbon multi-loop	Carbon multi-loop	anchored to bulb	anchored to bulb			
D	51		54647-1			2CP	125	S-8 *	SC							
C	52	RLS	34866-55	W-G		5W	8	S-11	SC	C-2R	C-2V	1 1/4 1 1/4	1/4 1/4	1,000	CLT-XNG	CLT-XNG
C	53	RLS		W-G	168741	5W	8	S-11	SC					1,000	CLT-SLT-XNG	
B	54	RLS	34866-58	W-G	192057	5W †3.5W	8	S-11	SC	C-2V	C-12	1 1/4 1 1/4	1/4 1/4	1,000	CLT-SLT-XNG	CLT-SLT-XNG
D	55	RLS	34866-43	W-G		10W	8	S-11	SC					C-2R	C-2V	1 1/4 1 1/4
B	56	RLS		W-G	142967	10W	8	S-11	SC	1,000	CLT-SLT-XNG					
A	57	RLS	34866-37	W-G	159440	13W †3.5W	8	S-11	SC	C-2V	C-12	1 1/4 1 1/4	1/4 1/4	1,000	CLT-SLT-XNG	CLT-SLT-XNG
D	58	RLS	34866-44	W-G		18W	8	S-11	SC					C-2R	C-2V	1 1/4 1 1/4
B	59	RLS		W-G	177731	18W	8	S-11	SC	1,000	CLT-SLT-XNG					
B	60	RLS	34866-78	W-G	199177	18W †3.5W	8	S-11	SC	C-2V	C-12	1 1/4 1 1/4	1/4 1/4	1,000	CLT-XNG	CLT-XNG
C	61	RLS	34866-34	W-G		15.3W	9	S-11	SC					C-2R		1 1/4

† LCL measured to top of filament.

ACTIVITY GROUP TABLE INCANDESCENT ELECTRIC LAMPS FOR RAILROAD SIGNAL PURPOSES—SPECIAL TYPES

Activity group	Item No.	Mfr. desg.	Source			Amps. Watts CP	Volts	Bulb	Base	Filament				Life hours	Railroad use	Principal railroads using
			GRS Dwg. No.	W-G	US&S PC. No.					Shape		LCL	Tolerance			
										MF	SF					
B	62	RLS		W-G	148970	5W	10	S-11	SC	S-Bulb C-2V	(Contd.)	1 1/4	1/64	1,000	CLT-SLT-XNG	AT&SF-ACL-CP-C&O-CRI&P-Erie-IC-MKT-StLSF-SP-Sou
B	63	RLS	34866-38	W-G		5W	10	S-11	SC	C-2R		1 1/4	1/64	1,000	CLT-SLT	B&M-CP-C&NW-CB&Q-FEC-L&N-MP-NYC-StLSF-Sou
B	64	RLS	34866-70	W-G	221513	5W †3.5W	10	S-11	SC	C-2V	C-12	1 1/4	1/64	1,000	CLT-SLT	C&NW-CGW-CRI&P-DM&IR-KCS-L&N-StLSF-Wab-WP
B	65	RLS		W-G	146930	10W	10	S-11	SC	C-2V		1 1/4	1/64	1,000	CLT-SLT-XNG	ACL-C&O-C&NW-CMStP&P-CRI&P-Erie-L&N-Sou-WofA-WP
B	66	RLS	34866-33	W-G		10W	10	S-11	SC	C-2R		1 1/4	1/64	1,000	CLT-SLT-XNG	B&O-B&M-CN-C&NW-KCS-MP-NYC-NP-Sou-T&P
A	67	RLS	34866-60	W-G	182814	13W †3.5W	10	S-11	SC	C-2V	C-12	1 1/4	1/64	1,000	CLT-SLT-XNG	CB&Q-CRI&P-CI&L-D&H-D&M-EJ&F-Erie-GTW-GM&O-IC-KCS-LV-L&N-NYC&StL-NYNH&H-PRR-Sou-StLSF-UP-Wab
A	68	RLS		W-G	151138	18W	10	S-11	SC	C-2V		1 1/4	1/64	1,000	CLT-XNG-CGA	AT&SF-ACL-B&M-C&O-C&NW-CMStP&P-CRI&P-Erie-GTW-GM&O-NC&StL-NYC&StL-N&W-PRR-Sou-UP
A	69	RLS	34866-29	W-G		18W	10	S-11	SC	C-2R		1 1/4	1/64	1,000	CLT-SLT-XNG	B&O-CP-C&O-C&NW-CRI&P-D&RGW-GM&O-KCS-LV-L&N-MP-NYC-NP-Rdg-Sou
B	70	RLS		W-G	175067	25W	10	S-11	SC	C-2V		1 1/4	1/64	1,000	CLT-SLT-XNG	ACL-CMStP&P-CRI&P-IC-NYNH&H-PRR-Rdg-UP-Wab
B	71	RLS	34866-47	W-G		25W	10	S-11	SC	C-2R		1 1/4	1/64	1,000	CLT-SLT-XNG	C&NW-D&H-GM&O-MP-NYNH&H-StLSF
A	72	RLS	34866-59	W-G	145877	11W	11	S-11	SC	C-2V		1 1/4	1/64	2,500	CLT-SLT-XNG-CGA	AT&SF-B&M-CP-DL&W-L&N-NC&StL-N&W-PRR-Rdg-StLSF-UP-WP
C	73	RLS		W-G	134832	11W	11	S-11	DC	C-2V		1 1/4	1/64	2,500	SLT	SP
A	74	RLS	34866-52	W-G	191859	14.4W †3.5W	11.3	S-11	SC	C-2V	C-12	1 1/4	1/64	1,000	CLT-SLT-XNG	CB&Q-NP
B	75	RLS	34866-25	W-G	135722	17W	13.5	S-11	SC	C-2V		1 1/4	1/64	2,000	CLT-CPLT-SLT-XNG	B&O-CI&L-GM&O-LV-NYC-NYC&StL-PRR-Wab
B	76	RS	50371-12	W-G	74066	2.5W	12	S-14	* S. Med	S-1		2 1/2	5/64	1,500	SEM	AT&SF-DM&IR-IGN-KCS-LV-MP-NYC-PRR-Sou
D	77	RS	50371	W		5W	12	S-14	* S. Med	S-1		2 1/2	5/64	1,500	SEM	KCS
B	78	RS	50371-14	W-G	144171	5W	14	S-14	* S. Med	S-1		2 1/2	5/64	1,500	SEM	CP-DM&IR-RF&P
C	79	RS		W-G		5W	32	S-14	* S. Med	S-1		2 1/2	5/64	1,500	SEM	AT&SF
C	80			W	209679	0.17A	14	T-3	* B. Min	C-2V		5/8	Red coating	250	IND-CTI	CNJ-StLSF
C	81			W	209711	0.17A	14	T-3	* B. Min	C-2V		5/8		250	IND-CTI	CNJ-StLSF
C	82	RS		W-G		0.15A	8	T-4	* S. Can	S-3		1		150	IND-CTI	C&NW

† LCL measured to top of filament.

ACTIVITY GROUP TABLE INCANDESCENT ELECTRIC LAMPS FOR RAILROAD SIGNAL PURPOSES—COMMERCIAL TYPES

Item No.	Mfr. desig.	Source			Amps. Watts CP	Volts	Bulb	Base	Filament			Life hours	Railroad use	Principal railroads using
		GRS Dwg. No.	WE W-G	US&S PC. No.					Shape	LCL	Tolerance			
501	25A-120V	44775-10	W-G		25W	120	A-19 I.F.	S. Med	C-9	A-Bulb $2\frac{1}{2}$ G-Bulb $\frac{3}{4}$		1,000	CTI	B&O-CN-CB&Q-L&N
502	No. 63	48088-4	W-G	97497	3CP	6-8	G-6	SC	C-2R			1,000	IND-LL-CTI	C&NW-CB&Q-CMStP&P-Erie-IC-IGN-NC&StL-NYC-SP
503	No. 63K		W-G	120467	3CP	6-8	G-6	S. Can	C-2R	$1\frac{1}{2}$ $\frac{3}{4}$		1,000	CTI	C&NW-CMStP&P-IC-MKT-N&W
504	No. 64		W-G	95829	3CP	6-8	G-6	DC	C-2R	$\frac{3}{4}$		1,000	IND-CTI	AT&SF-B&O-C&NW-CB&Q-Erie-IC-LV-L&N-NYC-N&W-NP-Sou-T&P
505	No. 67	48088-5	W-G	120270	3CP	12-16	G-6	SC	C-2R	$1\frac{1}{2}$ $\frac{3}{4}$		1,000	IND-LL-CTI	CMStP&P-PRR
506	No. 67K		W-G	95341	3CP	12-16	G-6	S. Can	C-2R	1		1,000	IND-LL-CTI	ACL-B&O-CP-C&O-C&NW-CB&Q-CMStP&P-Erie-IC-L&N-NYC-N&W-Sou-IC
507	No. 68	48088-6	W-G	116342	3CP	12-16	G-6	DC	C-2R	$1\frac{1}{2}$ $\frac{3}{4}$		1,000	IND-LL-CTI	CMStP&P-Erie-IC-L&N-NYC-N&W-Sou-IC
508	No. 89	48088-8	W-G		6CP	12-16	G-6	SC	C-2R	$\frac{3}{4}$		750	LL	FDDM&S-SL
509	No. 71	48088-3	W-G		3CP	18-24	G-6*	SC	C-2V	$\frac{3}{4}$		200	LL	LV
510	No. 71K		W-G	133192	3CP	18-24	G-6*	S. Can	C-2V	$1\frac{1}{2}$ $\frac{3}{4}$		200	IND	CMStP&P-MKT
511	No. 71M		W-G	120226	3CP	18-24	G-6*	S. Min	C-2V	$\frac{3}{4}$		200	IND-CTI	CMStP&P-Erie-PRR
512	No. 72		W-G	137964	3CP	18-24	G-6*	DC	C-2V	$\frac{3}{4}$		200	IND	T&NO
513	HDLT		W-G	95268	36W	120	G-18 $\frac{1}{2}$ *	S. Med	C-5	$2\frac{1}{2}$ $\frac{1}{4}$	$\frac{5}{64}$	1,000	CLT	AT&SF-CofP-NC&StL-RF&P-Union
514	No. 1133	34866-66	W-G		32CP	6-8	RP-11	SC	C-2V	RP-Bulb $1\frac{1}{4}$ S-Bulb $1\frac{1}{4}$	0.04-0.03	200	CLT	Sou
515	6S6-120V		W-G	186579	6W	120	S-6*	S. Can	C-7A	$1\frac{1}{2}$ $\frac{1}{8}$		1,500	IND-CTI-LL	CNJ-CMStP&P-IC-L&N-PRR
516	No. 87	48088-9	W-G	15CP		6-8	S-8	SC	C-2R	$1\frac{1}{2}$ $\frac{1}{8}$		300	CTI	NYC
517	No. 1129	34866-27	W-G	21CP		6-8	S-8	SC	C-2R	$1\frac{1}{4}$	0.04-0.03	200	CLT	AT&SF-CRI&P-LV-NYC-N&W-SP-T&P
518	No. 1141	34866-32	W-G	208229	21CP	12-16	S-8	SC	C-2R	$1\frac{1}{4}$	0.04-0.03	500	SEM-CLT-PLT-SLT-XNG-CGA	B&O-CG-CMStP&P-DL&W-LV-L&N-NYC-N&W-PRR-RF&P-Sou
519	No. 1142		W-G	21CP		12-16	S-8	DC	C-2R	$1\frac{1}{4}$	0.04-0.03	500	SEM-CLT	NYC
520		34866-77	W-G	15W		120	S-11*	SC	C-7A			750	SEM	B&O-C&NW
521	10S14-120V	44775-4	W-G	69494	10W	120	S-14*	S. Med	C-9	$2\frac{1}{2}$ $\frac{1}{4}$		1,500	SEM	B&O-C&M-CRI&P-MP-NYC-T&P
522	4A	52879	W-G		0.17-21A	4	T-2*	SL.1	C-6	T-Bulb			CTI	C&O-CI&L-GN-P&PU
523	E3		WE		0.12-16A	6	T-2*	SL.2	C-21				CTI	NYC
524	6A		G	240191	0.12-16A	6	T-2*	SL.3	C-21				CTI	B&O
525	8A		G	240192	0.08-10A	8	T-2*	SL.3	C-21				CTI	AT&SF-CRI&P
526	G1		WE		0.085-10A	8	T-2*	SL.2	C-21				CTI	AT&SF-MP-UP
527	J1		WE		0.23-27A	10	T-2*	SL.2	C-21				CTI	ACL-CB&Q-CMStP&P-CRI&P-StLSF-SAL-SP

ACTIVITY GROUP TABLE INCANDESCENT ELECTRIC LAMPS FOR RAILROAD SIGNAL PURPOSES—COMMERCIAL TYPES

Item No.	Mfr. desg.	Source			Amps. Watts CP	Volts	Bulb	Base	Filament			Life hours	Railroad use	Principle railroads using
		GRS Dwg. No.	WE W-G	US&S PC. No.					Shape	LCL	Tolerance			
528	10B	52879-1	G	240193	0.23-0.27A	10	T-2*	SL.2	C-21	T-Bulb	(Contd.)	3,000	CTI	ACL-A&S-B&M-C&O-CMStP&P-CRI&P B&O-B&M-C&NW-CB&Q-LV-L&N-NP-Sou
529	12A		W-G		0.09-0.11A	12	T-2*	SL.1	C-21				CTI	
530	12A	52879-6	G	240185	0.09-0.11A	12	T-2	SL.3	C-21	Carbon C-21		3,000	CTI	C&EI-CB&Q-CMStP&P-DL&W-Erie-L&N-N&W-StLSF-StLSW-T&NO AT&SF-CB&Q B&O-B&M-C&O-DM&IR-EJ&E-Erie-GN-LV-L&N-NYC-StLSF-SAL C&O-GTW-PRR-StLSF-W&LE CRI&P-D&M-PRR CRI&P CI&L-NP-Rdg-UP PRR
531	2F		WE		0.105-0.12A	12	T-2*	SL.2	Carbon				CTI	
532	12C	52879-3	W-G		0.17A	12	T-2*	SL.1	C-21	Carbon C-21		3,000	CTI	
533	12C		G	240199	0.17A	12	T-2*	SL.3	C-21				CTI	
534	15A	52879-2	G	240186	0.09-0.11A	15	T-2*	SL.3	C-21	Carbon C-21		3,000	CTI	C&O-CRI&P-CB&Q-DL&W-NYNH&H-StLSF-SAL-Wab-UP-WP AT&SF-B&M-CMStP&P-CRI&P-Erie NYC-P&LE CP-C&NW-D&M-LV-L&N-NYC-NYNH&H-NP-Sou
535	2C		WE		0.103-0.120A	15	T-2*	SL.2	Carbon				CTI	
536	16A	52879-5	W-G		0.09-0.11A	16	T-2*	SL.1	C-21	Carbon C-21		3,000	CTI	AT&SF-B&M B&O-CB&Q-D&H-D&M-StLSF-Sou-T&P-UP D&H-LV ACL-PRR PRR
537	16A		G	287000	0.09-0.11A	16	T-2*	SL.3	C-21				CTI	
538	18A	52879-9	G	240194	0.035-0.045A	18	T-2*	SL.3	C-21	Red coating		3,000	CTI	
539	B2		WE		0.036-0.048A	18	T-2*	SL.2	C-21				CTI	
540	2R	52879-4	WE		0.09-0.12A	18	T-2*	SL.2	Carbon	Yellow coating		3,000	CTI	T&P-CB&Q GTW-T&P GTW-T&P GTW-T&P
541	20A		G	286763	0.06-0.085A	20	T-2*	SL.3	C-21				CTI	
542	24E	52879-7	W-G		0.032-0.038A	24	T-2*	SL.1	C-21	Green coating		200	IND-CTI	
543	2G		WE		0.075-0.115A	24	T-2*	SL.2	Carbon				CTI	
544	24D	52879-8	W-G		0.09-0.11A	24	T-2*	SL.1	C-21	1% coating		200	CTI	B&O
545	24D-R		W-G		0.09-0.11A	24	T-2*	SL.1	C-21				CTI	
546	C2	43198-11	WE		0.032-0.044A	36	T-2*	SL.2	C-21	1% coating		3,000	CTI	B&O
547	36A		G	240197	0.035-0.045A	36	T-2*	SL.3	C-5				CTI	
548	40B	43198-17	G	283860	0.035-0.045A	40	T-2*	SL.3	C-5	1% coating		3,000	CTI	
549	No. 40		W-G		0.15A	6-8	T-3/4*	S. Min	C-2R				IND	
550	No. 40Y	43198-18	W-G		0.15A	6-8	T-3/4*	S. Min	C-2R	1% coating		3,000	CTI	B&O
551	No. 40R		W-G	296704	0.15A	6-8	T-3/4*	S. Min	C-2R				CTI	
552	No. 40G	43198-22	W-G		0.15A	6-8	T-3/4*	S. Min	C-2R	1% coating		3,000	CTI	
553	No. 1488		W-G		0.15A	14	T-3/4*	B. Min	C-2R				CTI	
554	No. 1488-R	57026-3	W-G		0.15A	14	T-3/4*	B. Min	C-2R				CTI	

(Revision of A.A.R. Signal Section Specification 231-50)
A.A.R. SIGNAL SECTION SPECIFICATION 231-52.

ILLUMINATED INDICATORS AND SIGNS

1. *Purpose.*

(a) This specification is for the purpose of providing for illuminated indicators and signs which display a legend only when illuminated from inside the case. It sets forth specific detail requirements representing modern signal practice recommended for new installations and for replacement on existing installations when general renewal or replacement becomes desirable.

2. *Specifications and drawings.*

(a) Specifications and drawings referred to in the body of this specification form an essential part hereof.

(b) Manufacturer shall furnish with his tender, drawings forming an essential part thereof.

3. *Tender.*

(a) The tender shall be for a product meeting the requirements of this specification in its entirety.

4. *Purchaser's order requirements.*

(a) The following additional requirements will be shown on the Purchaser's order:

1. Purchaser's drawing or other reference.
2. Supporting bracket as required:
 - (a) For front of mast.
 - (b) For side of mast.
 - (c) For 4 in., 5 in., 6 in., or 8 in. pipe.
3. Lamp voltage and wattage rating.
4. Legend as required, per section 9-b.
5. Inspection and tests as required.
6. Alternate requisites as required.

5. *Alternates.*

(a) The provisions contained in the alternate requisites section of this specification form a part hereof only when substituted by Purchaser's order for the provisions contained in this specification.

6. *Material and workmanship.*

(a) Material and workmanship shall be first-class in every respect.

7. Design.

(a) Electric light unit shall be designed to conform to Drawing 1481 or 1514.

(b) Case and door shall be cast aluminum alloy in accordance with A.S.T.M. current Specification B 26, alloy number and treatment as required. *R-7-b.

(c) The case shall be designed to enclose a 14 in. diameter reflector and an electric lamp mounted at its focal point.

(d) The door shall be designed to support a convex roundel and associated parts necessary to produce the legend desired.

(e) Design shall be such that the reflector, roundel and associated parts may be cleaned without disturbing the adjustment of the lamp.

(f) Door and roundel shall be provided with durable water-proof gaskets which shall be fastened securely in place to prevent the entrance of dust or moisture.

(g) Door shall open in front, be hinged at side or bottom, and be provided with means for compressing the door against the housing.

(h) The case shall be designed for attachment to bracket 14851, Drawing 1485, and when mounted shall conform to Drawing 1482, 1483, 1515 or 1516.

(i) The legend shall be legible only when illuminated from inside the case.

1. An inner convex roundel of clear glass shall have the legend outlined in a black background of baked enamel.

2. An outer convex roundel of clear glass with the concave surface lightly sand-blasted shall be separated approximately 1 in. from the inner roundel.

3. A suitable arrangement of non-reflecting black honey-comb cells shall fill the space between roundels so as to screen the interior from the possibility of illuminating the legend by reflection of external light.

(j) Machine screws, washers, bolts, nuts and hinge pins shall be of corrosion-resisting metal or suitably plated. Zinc or cadmium shall not be used on parts carrying current.

(k) A breather opening with suitable filter shall be provided at bottom of case.

8. Terminals and wiring.

(a) Terminals in the case shall be conveniently located and shall be mounted on insulating block or blocks.

(b) Flexible copper wires not less than No. 18 A.W.G. single conductor, suitably insulated, shall be provided between lamp receptacle and terminals and be securely fastened to prevent breakage.

(c) Wire eyelets shall be provided on each wire attached to terminal posts.

* Alternate requisites section.

9. *Roundels.*

(a) Roundels shall be of clear glass 14 inches in diameter, convex, and treated per section 7-i.

(b) Legend shall be as specified by the Purchaser:

1. "No Right Turn"—Drawing 1487.

2. "No Left Turn"—Drawing 1487.

3. "S"—Drawing 1513.

4.

10. *Hood.*

(a) A hood shall be provided over the outer roundel projecting no less than 10 in. substantially at right angles to the case and extending around the entire upper half of the roundel.

(b) Hood shall be made of copper-bearing sheet steel, not less than 0.0478 in. thick, suitably treated to resist corrosion.

11. *Reflector.*

(a) The reflector shall be of glass of the Mangin or parabolic type and shall have a reflecting surface of proper diameter to project substantially parallel light rays in a cylindrical beam equal to the effective diameter of the roundel used.

(b) The reflector shall be constructed as follows:

1. The reflective backing shall consist of a heavy homogeneous coating of pure metallic silver, evenly applied. The coating shall be applied over clean smooth glass and shall be applied in such a manner that no foreign substance remains between it and the glass. The coating shall adhere firmly and so closely to the glass that the admission of any foreign substance will be prevented.

2. Over the silver there shall be applied electrolytically a heavy coat of metallic copper of such thickness as to reinforce the silver reflective backing and protect it from atmospheric conditions. The copper shall extend over the edge of the mirror at least one-fourth the thickness of the glass. Over the copper backing shall be placed one or more coats of paint or enamel of such quality as to render the greatest resistance possible to the admission of moisture or gases. The paint or enamel shall withstand ordinary handling without scratching or chipping.

12. *Reflector tests.*

(a) Reflectors shall meet the following test:

1. The reflector shall be immersed for 24 hours at room temperature in a solution composed of clean water and 20 per cent by weight of salt. It shall then be removed from the salt solution and rinsed in clean water, after which it shall be placed in clean water at room temperature and gradually heated to a temperature of 170 deg. F. and maintained at that temperature for 4 hours. The reflector shall

12. *Reflector tests.*—Continued.

then be removed from the water and placed in dry air at 170 deg. F. for 4 hours.

2. After this test, the backing on the reflector shall show no chipping, cracking or softening of the coatings and shall show no separation of the backing into layers, or from the mirror surface, and no appreciable change in the color of the backing or the silver reflecting surface.

13. *Receptacle.*

(a) Case shall be provided with a candelabra single contact bayonet lamp receptacle on rigid support so that a $\frac{1}{64}$ in. precision based lamp having a light center length of $1\frac{1}{4}$ in. will have its filament at the focal point of reflector. Receptacle shall be insulated from the case and reflector support.

(b) Receptacle shall be adjusted and sealed in position at the factory. *R-13-b.

14. *Range and spread.*

(a) The legend, when illuminated by a 10-volt 25-watt lamp of 1,000 hours design life, based accurately to $\frac{1}{64}$ in. precision, operating at 9 volts, shall have, in bright sunlight:

1. Light visibility range:

(a) In excess of 300 ft. for "No Right Turn" or "No Left Turn" legend.

(b) In excess of 800 ft. for "S" legend.

2. Message legibility range:

(a) 200 ft. for "No Right Turn" or "No Left Turn" legend.

(b) 500 ft. for "S" legend.

(c) A satisfactory close-up indication shall be displayed.

15. *Background.*

(a) Background shall not be provided. *R-15-a.

16. *Painting.*

(a) Cast aluminum case and door shall be given an approved surface treatment to provide for paint adherence.

(b) Primer coat shall be zinc chromate type.

(c) Finish coats for case and door shall be in accordance with treatment for castings per Specification 120, Manual Part 110.

(d) Other metal parts shall be painted in accordance with Specification 120, Manual Part 110.

* Alternate requisites section.

17. *Binding posts.*

- (a) Nuts and washers shall conform to Drawing 1070 for 14-24 post.
- (b) Binding posts shall conform to Drawing 1070 or 1078 and shall have 14-24 thread.
- (c) Binding posts shall be mounted so they cannot be turned in the base or frame to which applied. They shall be properly insulated from each other and other metallic parts.

18. *Dielectric requirements.*

- (a) Electrical apparatus assembled shall withstand for 1 minute an insulation test, at place of manufacture, of 3,000 volts a.c. between all parts of electric circuits and other metallic parts insulated therefrom, except the lamp receptacle which shall withstand for 1 minute an insulation test of 800 volts a.c.
- (b) With the exception of the lamp receptacle, a surface leakage distance of not less than $\frac{1}{4}$ in. shall be provided between any exposed metallic part of the apparatus carrying current and any other metallic part thereof.

19. *Identification.*

- (a) Case or door shall be plainly marked with Manufacturer's name or trade-mark.

20. *Inspection.*

- (a) Purchaser may inspect the material or product at all stages of manufacture.
- (b) Purchaser may inspect the completed product to determine that the requirements of this specification have been met.
- (c) If product has not been accepted at point of production and if, upon arrival at destination, it does not meet the requirements of this specification, it may be rejected, and the Manufacturer, upon request, shall advise the Purchaser what disposition is to be made of the rejected product. Manufacturer shall pay all freight charges.
- (d) If Purchaser is to make inspection at point of production it shall be so stated on Purchaser's order.

21. *Tests.*

- (a) Tests may be made at point of production, or on samples submitted, and may also be made at destination.
- (b) Manufacturer shall give the Purchaser sufficient notice of time when the material or product will be ready for testing.
- (c) Manufacturer shall provide, at point of production, apparatus and labor for making required tests under supervision of the Purchaser.
- (d) If tests are to be made at point of production, it shall be so stated on Purchaser's order. The Purchaser shall indicate which of the tests herein specified are to be made and what portion of the material or product shall be tested.

22. *Packing.*

(a) Product shall be so assembled or packed as to permit convenient handling and to protect against loss or damage during shipment.

23. *Marking.*

(a) Purchaser's order, requisition and package number, name of Consignor, and name and address of Consignee, shall be plainly marked on outside of packages and on tags attached to loose pieces.

(b) Detail list of loose pieces, packages and their contents shall be furnished for each shipment.

24. *Warranty.*

(a) Manufacturer shall warrant the product covered by this specification to be free from defects in material and workmanship under ordinary use and service, his obligation under this warranty being limited to manufacturing, at point of production, any part or parts to replace those which shall be found defective within 1 year after shipment to the Purchaser. This warranty shall not apply to any product which shall have been repaired or altered in any way by anyone other than the Manufacturer thereof, so as to affect, in the Manufacturer's judgment, its proper functioning or reliability, or which has been subjected to misuse, negligence or accident.

Alternate requisites.

R-7-b.

Case and door shall be one of the following, as specified by Purchaser:

1. Die cast alloy, in accordance with A.S.T.M. current Specification B 86, Alloy XXI or XXIII.
2. Cast iron, in accordance with A.S.T.M. current Specification A 48, Class 20.

R-13-b.

Receptacle shall be adjusted and fixed in position at the factory, but not sealed.

R-15-a.

1. Background shall be provided and shall be copper-bearing sheet steel not less than 0.0478 in. thick. It shall be adaptable for assembly in the field without use of special tools. It shall be

Alternate requisites.—Continued.

painted with a suitable^m primer and non-reflecting black finish coat per Specificationⁿ 214, Manual Part 221.

2. Diameter shall be:

- (a) 30 in.
- (b) 35 in.
- (c)

Action Recommended

Acceptance for submission to letter-ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Specification 231-50—"No Right Turn"—"No Left Turn" Illuminated Sign, Manual Part 237.

COOPERATIVE REPORT

AMERICAN STANDARDS ASSOCIATION
SECTIONAL COMMITTEE ON THE STANDARDIZATION AND
UNIFICATION OF SCREW THREADS—PROJECT B1*

W. G. Brown, Representative

Because of A.S.A. B1.1-1935 having been revised and published as A.S.A. B1.1-1949, Unified and American Screw Threads for Screws, Bolts, Nuts and Other Threaded Parts, A.S.A. B1.2-1941 was revised, approved September 6, 1951 and published as A.S.A. B1.2-1951, Screw Thread Gages and Gaging.

Action Recommended

Acceptance as information.

* Previous report on this subject appears in A.A.R. Signal Section 1950 Proceedings, Vol. XLVIII, pp. 288 and 411.

COMMITTEE VII—MATERIALS RESEARCH

Personnel

E. A. Burgin, Chairman
K. Chamberlain, Vice-Chairman

F. E. Beutler	J. C. Hoffman
A. L. Essman	Curtis Kies
G. E. Goeppert	C. T. Marak
T. T. Hart	J. Mooney, Jr.
W. W. Hartzell	J. A. Moore
C. W. Hoffman	T. B. Thompson
W. K. Waltz	

Signal Section, A.A.R.:

The following outline of work has been assigned:

1. Revision of Manual.
2. Indexing signal literature.
3. Investigate and report on rust preventives, segregating into classifications.
4. Investigate and report on means for determining colors for target enamel covered in Specification 227, Manual Part 235, and prepare recommended colors.
5. Investigate and report on the use of stainless steel guy and messenger strand.
6. Investigate and report on wash primers.
7. Investigate and report on test installations of aluminum or newer or better steel alloys for relay and instrument housings.
8. Investigate and report on preparation of aluminum surfaces for painting.
9. Specification for ready-mixed aluminum paint.

The Committee submits for consideration, reports on the following subjects*:

1. Revision of Specification 200-43, Manual Part 62.
Revision of Specification 120-51, Manual Part 110.
Revision of Specification 13-39, Manual Part 58.
Requisites for Fabricated Fibre Parts for Track Insulation.
Revision of Specification 77-41, Manual Part 111.
Revision of Specifications for Various Types of Non-Ferrous Metals and Alloys, Manual Part 220.
Revision of Specification 217-46, Manual Part 222.
Revision of Specification for Signal Colors Exclusive of Signal Glasses, Manual Part 273.

* Suggestions or criticisms should be submitted in writing to the Chairman of the Committee on or before September 1, 1952.

3. Field uses of rust preventives.
5. Use of stainless steel guy and messenger strand.
6. Wash primers.
8. Preparation of aluminum surfaces for painting.
9. Specification 259-52.

Explanatory

Manual Part 273, Specification for Signal Colors Exclusive of Signal Glasses, refers to color samples prepared by the Federal Bureau of Aeronautics and the U. S. Army. Reproductions of these colors now appear in the recently issued Federal Specification TT-C-595, Colors (for) Ready-Mixed Paints, which can be purchased from the Superintendent of Documents and since it is relatively difficult to obtain color samples from the Bureau of Aeronautics, Committee VII herein presents a revision of Manual Part 273 in which reference is made to color samples appearing in Federal Specification TT-C-595.

Information

Specifications, etc., of other organizations referred to in the report of this Committee may be procured from the following:

A.S.T.M.—American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.

Federal Specifications—Superintendent of Documents, Government Printing Office, Washington 25, D. C.

Disposition of 1951 Letter Ballot Subjects

The following subjects presented by Committee VII at the 1951 Annual Meeting were submitted to letter ballot and officially approved:

Specification 144-51—Dry Process Porcelain Insulation—Now in Manual Part 80.

Specification 120-51—Painting—Now in Manual Part 110.

Specifications for Various Types of Steel—Now in Manual Part 154.

(Revision of A.A.R. Signal Section Specification 200-43)
A.A.R. SIGNAL SECTION SPECIFICATION 200-52.

ALUMINUM PAINT (READY-TO-MIX)

1. *Purpose.*

(a) This specification is for the purpose of providing for a ready-to-mix, aluminum paint applicable for use on metal and masonry surfaces. It sets forth specific detail requirements representing modern signal practice recommended for the painting of new installations and for the repainting of existing installations when general renewal or repainting becomes desirable.

2. *Specifications.*

(a) Specifications referred to in the body of this specification form an essential part hereof.

3. *Tender.*

(a) The tender shall be for products meeting the requirements of this specification in its entirety.

4. *Purchaser's order requirements.*

(a) The following additional requirements will be shown on the Purchaser's order:

1. Size and kind of containers.
2. Inspection and tests as required.
3. Alternate requisites as required.

5. *Alternates.*

(a) The provisions contained in the alternate requisites section of this specification form a part hereof only when substituted by Purchaser's order for the provisions contained in this specification.

6. *Material and workmanship.*

(a) Material and workmanship shall be first-class in every respect.

7. *Requirements.*

(a) General.

1. The paint shall consist of two parts, aluminum pigment and vehicle, supplied in separate containers, which shall be mixed just prior to application.
2. The paint shall be suitable for brush or spray application.

7. *Requirements.*—Continued.(b) *Pigment.*

1. The pigment shall consist of commercially pure aluminum in the form of fine flakes uniformly dispersed in mineral spirits to form a paste which shall conform to the following requirements (*R-7-b-1):

(a) At least 65 per cent by weight of the paste shall be matter non-volatile at 221 to 230 deg. F. (essentially aluminum flakes).

(b) The paste shall contain an easily extracted fatty or oily matter (polishing lubricant) in the amount of 3 per cent maximum, by weight of the paste.

(c) When the paste is washed through sieves with alcohol or mineral spirits, not more than 1 per cent, by weight of the paste, shall be coarse particles retained on a No. 325 sieve.

(d) The aluminum flakes shall remain permanently in suspension in the paste and there shall be no separation of mineral spirits from the aluminum flakes in the container.

(e) The leafing properties of the aluminum pigment paste shall be not less than 50 per cent.

(f) The mineral spirits in which the aluminum flakes are dispersed to form the pigment paste, shall be completely volatile at 220 deg. F. and shall be in accordance with current Federal Specification TT-T-291, Thinner; Paint, Volatile Mineral Spirits (Petroleum Spirits).

(g) The pigment paste shall not contain mica, fillers or other adulterants and the total impurities (other than fatty and oily matter) shall be not more than 0.7 per cent by weight of paste.

(c) *Vehicle.*

1. The vehicle shall be an alkyd resin base varnish and shall conform to the following requirements (*R-7-c-1, No. 1 or No. 2):

(a) Phthalic anhydride content: Not less than 25 per cent (based on solids content).

(b) Thinner: The volatile thinner shall be free from toxic hydrocarbons, such as benzol or chlorinated hydrocarbons.

(c) Driers: The vehicle shall be free from lead, manganese, calcium or zinc driers.

(d) Rosin or rosin derivatives content: None.

(e) Clarity: Clear, transparent and free from sediment and suspended matter when examined by transmitted light.

* Alternate requisites section.

7. *Requirements.*—Continued.

(f) Viscosity: Between 0.65 and 1.25 poises at 77 deg. F., corresponding to Tubes B to E of the Gardner-Holdt Air Bubble Viscometer.

(g) Flash point: Not less than 86 deg. F. in a closed cup tester.

(h) Non-volatile matters: Not less than 48 per cent, by weight, of non-volatile oils and resins.

(i) Acid number: Not more than 7 (based on non-volatile content).

(j) Skinning: None after 48 hours in a three-fourths filled, tightly closed container.

(k) Flexibility (cold cracking): A flow out film on a No. 28 gage tin plate panel, air-dried 18 hours and then baked at 179.6 to 185 deg. F. for 2 hours; suddenly chilled to 32 deg. F. and then bent rapidly 180 deg. around a $\frac{1}{8}$ in. diameter rod, shall not show cracking or loosening of the film.

(l) Adhesion: The film on the bent portion of panel used in section 7-c-1-k, shall show "good adhesion" when tested with a knife edge, in accordance with paragraph 15K of U. S. Army Specification No. 3-1F.

(m) Appearance: A flow out film on colorless glass, air-dried 18 hours and then baked at 180 to 185 deg. F. for not less than 2 hours, shall be hard, tough, smooth, transparent and free from defects such as checking, dulling or wrinkling.

(n) Water immersion resistance: A flow out film on a No. 28 gage tin plate panel, air-dried 48 hours, shall withstand immersion in cold water for 18 hours without whitening and shall show only slight dulling. After removal from the water for 2 hours, the original gloss and hardness shall return.

(o) Gasoline immersion resistance: A flow out film on a No. 28 gage tin plate panel, air-dried 72 hours, shall withstand immersion in straight run gasoline for 24 hours without loss of gloss or change in appearance. After removal from the gasoline and air-dried 4 hours, the film shall have regained its initial hardness and toughness. There shall be no dissolution effect on the lower immersed edge.

(p) Drying time: Aluminum paint made with this vehicle, when applied to a metal panel and allowed to air-dry in a vertical position, shall require not less than 1 hour nor more than $2\frac{1}{2}$ hours to set to touch and shall dry hard and tough in not more than 18 hours at a temperature of 68 to 86 deg. F.

(q) Mixing properties: Aluminum paint made with this vehicle by thoroughly mixing with the specified pigment in the proportion of 2 lbs. of pigment to 1

7. *Requirements.*—Continued.

gallon of vehicle, when applied to a vertical, smooth, metal surface, shall show good leafing property, satisfactory brushing and leveling properties and shall not break or sag.

8. *Mixing.*

(a) Aluminum paint made to this specification shall be mixed on the job and only enough for one day's work shall be mixed at one time. Any paint remaining after this period may be combined with freshly prepared paint if it does not exceed 10 per cent of the newly-mixed paint.

(b) The paint shall be mixed in the proportion of 2 lbs. of pigment to 1 gallon of vehicle. The weighed amount of pigment shall be placed in a suitable mixing container and a measured volume of vehicle shall be gradually added to it with continuous stirring until a uniform mixture is obtained. Each time paint is removed from the mixing container, the paint, before removal, shall be thoroughly stirred to maintain the proper consistency. The paint shall also be occasionally stirred during use.

9. *Application.*

(a) Application of aluminum paint (ready-to-mix) shall be in accordance with Specification 120, Manual Part 110.

10. *Tests.*

(a) Tests may be made at point of production, or on samples submitted, and may also be made at destination.

(b) Manufacturer shall give the Purchaser sufficient notice of time when the material or product will be ready for testing.

(c) Manufacturer shall provide, at point of production, apparatus and labor for making required tests under supervision of the Purchaser.

(d) If tests are to be made at point of production, it shall be so stated on Purchaser's order. The Purchaser shall indicate which of the tests herein specified are to be made and what portion of the material or product shall be tested.

(e) Tests required in sections 7-b and 7-c and in the alternate requisites section, except as otherwise specified, shall be conducted in accordance with the methods described in Federal Specification TT-P-141b as follows:

Test for	Method of testing as shown in Fed. Spec. TT-P-141b
Phthalic anhydride content.....	702.1
Rosin or rosin derivatives.....	503.1
Driers.....	723.1
Viscosity.....	427.1
Flash point.....	429.1
Non-volatile matter.....	405.3
Acid number.....	507.3

10. *Tests.*—Continued.

Test for	Method of testing as shown in Fed. Spec. TT-P-141b
Skinning.....	414.1
Elasticity and toughness.....	415.1
Flexibility (cold cracking).....	622.3
Gas test.....	416.1
Draft test.....	417.1
Water immersion resistance.....	601.1
Gasoline immersion resistance.....	601.1
Alkali and acid immersion resistance.....	601.1
Drying time.....	406.1
Mixing properties.....	455.1

11. *Inspection.*

(a) The products furnished under this specification may be accepted upon Manufacturer's certificates of guarantee insuring that they are in accordance with the specification. If on arrival at destination the products are found not to meet the requirements of the specification they may be rejected and the Manufacturer, upon request, shall advise the Purchaser what disposition is to be made of the rejected products. Manufacturer shall pay all freight charges.

12. *Containers.*

(a) Products shall be furnished in duplex containers, 1 gallon cans, or steel drums as specified by the Purchaser.

13. *Packing.*

(a) Products shall be so assembled or packed as to permit convenient handling and to protect against loss or damage during shipment.

14. *Marking.*

(a) Purchaser's order, requisition and package number, name of Consignor, and name and address of Consignee, shall be plainly marked on outside of packages and on tags attached to loose pieces.

(b) Detail list of loose pieces, packages and their contents shall be furnished for each shipment. Where carload shipments are made, routing and car identification shall be shown.

15. *Warranty.*

(a) Manufacturer shall warrant the products covered by this specification to be free from defects in material and workmanship under ordinary use and service, his obligation under this warranty being limited to manufacturing, at point of production, any part or parts to replace those which shall be found defective within one year after shipment to the Purchaser. This warranty shall not apply to any product which has been subjected to misuse, negligence or accident.

Alternate requisites.

R-7-b-1.

The pigment shall consist of commercially pure aluminum powder in the form of fine polished flakes and shall conform to the following requirements:

(a) At least 99 per cent, by weight of the powder, shall be matter non-volatile at 221 to 230 deg. F. (essentially aluminum flakes).

(b) When the powder is washed through sieves with alcohol or mineral spirits, not more than 1.5 per cent, by weight of the powder, shall be coarse particles retained on a No. 325 sieve.

(c) The powder shall contain an easily extracted fatty or oily matter (polishing lubricant) in the amount of 4 per cent maximum, by weight of the powder.

(d) The leafing properties of the aluminum pigment powder shall be not less than 50 per cent.

(e) The pigment powder shall not contain mica, filler or other adulterants and the total impurities (other than fatty and oily matter) shall not be more than 1 per cent by weight of powder.

R-7-c-1, No. 1.

The vehicle shall be a phenolic resin base varnish of a long oil type and shall conform to the following requirements:

(a) Phenolic resin content: 100 per cent (based on solids content).

(b) Oil: Shall be a suitable vegetable drying oil as is necessary to meet the requirements of this specification.

(c) Thinner: Shall be free from toxic hydrocarbons, such as benzol or chlorinated hydrocarbons.

(d) Driers: The vehicle shall be free from lead, manganese, calcium or zinc driers.

(e) Rosin or rosin derivatives content: None.

(f) Clarity: Clear, transparent and free from sediment and suspended matter when examined by transmitted light.

(g) Viscosity: Between 0.65 and 1.25 poises at 77 deg. F., corresponding to Tubes B to E of the Gardner-Holdt Air Bubble Viscometer.

(h) Flash point: Not less than 86 deg. F. in a closed cup tester.

(i) Non-volatile matter: Not less than 50 per cent, by weight, of non-volatile oils and resins.

(j) Elasticity and toughness: Shall pass a 100 per cent Kauri Reduction Test.

(k) Skinning: None after 48 hours in a three-fourths filled, tightly closed container.

(l) Gas and draft tests: Shall pass satisfactorily.

Alternate requisites.—Continued.

R-7-c-1, No. 1.—Continued.

(m) Water immersion resistance: Flow out films on No. 28 gage tin plate panels, air-dried 72 hours, shall withstand immersion in cold water for 96 hours and in hot water (167 deg. F.) for 6 hours without whitening, dulling, checking, blistering or showing other serious defect.

(n) Alkali and acid immersion resistance: Films applied to test tubes (dimensions 6 in. by 1 in.) by immersion in varnish to a depth of 4 inches and dried in an inverted position for 72 hours shall show no whitening, dulling, or visible attack when immersed to a depth of 2 inches in a 5 per cent solution of sodium hydroxide for 6 hours (at 68 deg. F.) and (a separate similar film) in a 4 per cent solution of acetic acid for 24 hours (at 68 deg. F.).

(o) Gasoline immersion resistance: A flow out film on a No. 28 gage tin plate panel, air-dried 48 hours, shall be immersed in straight run gasoline for 48 hours. After air drying for 2 hours, the film shall show no whitening, dulling, or visible attack.

(p) Drying time: Aluminum paint made with this vehicle, when applied to a metal panel and allowed to air-dry in a vertical position, shall require not less than 1 hour nor more than 3 hours to set to the touch and shall dry hard and tough in not more than 18 hours at a temperature of 68 to 86 deg. F.

(q) Mixing properties: Aluminum paint made with this vehicle by thoroughly mixing with the specified pigment in the proportion of 2 lbs. of pigment to 1 gallon of vehicle, when applied to a vertical, smooth metal surface, shall show good leafing property, satisfactory brushing and leveling properties and shall not break or sag.

R-7-c-1, No. 2.

The vehicle shall be and shall conform to the following requirements:

- (a)
- (b)
- (c)

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Specification 200-43—Aluminum Paint Suitable for Finishing Coats on Steel Structures, Manual Part 62.

(Revision of A.A.R. Signal Section Specification 120-51)
A.A.R. SIGNAL SECTION SPECIFICATION 120-52.

PAINTING

Proposed Revision

5. *General.*

(a) Paint prescribed for application to apparatus as covered in this specification shall be in accordance with the following:

2. Finishing paints and enamels.

(a) Aluminum Paint (Ready-to-Mix)—Specification 200, Manual Part 62.

(b) Aluminum Paint (Ready-Mixed)—Specification 259, Manual Part

(Present sections 5-a-2-b through 5-a-2-h become 5-a-2-c to 5-a-2-i, inclusive.)

8. *Application.*

(a) Paint may be applied by brushing, dipping or spraying and may be air dried or baked.

(b) When applying aluminum paint by brushing, care should be taken to make final strokes in the same direction. Excessive brushing will result in streaking and darkening. When applied by spraying, only sufficient pressure shall be used to ensure adequate distribution. Excessive pressure will result in a non-uniformity of the film.

(Present sections 8-b through 8-f become 8-c to 8-g, inclusive.)

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Sections 5-a-2 and 8 of Specification 120-51—Painting, Manual Part 110.

WASH PRIMERS

An effective method to protect metal surfaces against rust and corrosion has long been sought by industry. To be successful in this respect, the metal surface must be thoroughly treated by an initial coating which will be impervious to moisture, resistant to corrosive action, and at the same time provide a base upon which subsequent conventional paint primers and finishes may become firmly attached.

Prior to 1941 a generally accepted method for the surface pretreatment of metal was to cleanse the surface thoroughly, then apply a phosphoric acid type of treatment immediately after which paint coatings could be applied. This type of treatment in some instances did not assure satisfactory results, particularly when applied in very cold weather; the desired adhesive qualities were found to be lacking and subsequent paint coats would peel and blister.

The necessity for improvement in the surface treatment of the hulls of seagoing vessels became urgent at the outset of World War II and extensive research and development work followed, which resulted in the introduction of a new type of metal treatment. This treatment was subsequently classified as a "wash primer." (This term is a misnomer in that it does not require that the treatment be applied by washing, neither is it intended to replace other existing types of conventional primers. It is essentially a method employed in the treatment of metal surfaces prior to the application of existing types of conventional primers.) This wash primer was, and still is, furnished in two packages. One of the packages contained polyvinyl butyral resin mixed with insoluble zinc chromate combined with suitable solvents; the other package contained an acid diluent composed of phosphoric acid mixed with suitable solvents. The contents of the two packages were combined in the proportions recommended by the manufacturer.

As a result of this research and development, wash primers are now commercially available and are used extensively. It is claimed these wash primers will adhere strongly to steel, stainless steel, iron, galvanized iron, aluminum, magnesium, copper, brass, cadmium, nickel, chromium, zinc, and tin. Unlike most other primers, they may also be applied over slightly damp surfaces without loss of adhesion. Generally, wash primers can be expected to adhere more tightly to all surfaces than will most paints; however, it should be remembered that to produce the best results, the usual procedures with respect to surface cleanliness must be observed.

Wash primers may be applied by brushing, spraying, rolling, flowing, or dipping, although two-package systems are not generally used for dipping purposes due to the considerable amount wasted because of the relatively short stability life. As mixed primers quickly lose their effectiveness, becoming unfit for use after a period of 8 hours, application after that time is not recommended.

For best results a wash primer should be applied as soon as possible after the surface is cleaned. Being formulated with low solids and solvents having low surface tension, it will inherently penetrate into pits in the surface of the metal, but to ensure that complete coverage is effected, a second application should be made over seams and laps after the first application has dried. The recommended film thickness of the wash primer is 0.2 to 0.5 mil which is the normal

film thickness obtained with one application. On films thicker than 0.5 mil the drying is retarded and the resultant film has a tendency to remain spongy and porous. When applied at recommended film thickness the drying time at room temperature will not exceed 15 minutes; this can be reduced to a matter of seconds under a hot air blast. Such quick drying qualities permit the rapid application of succeeding paint coats.

Wash primers were originally formulated as a base for subsequent vinyl coatings. All other types of paint coatings show excellent adherence to wash primers except some pyroxylin lacquers. These, however, can be so formulated as to produce equally good results.

Realizing that there are some disadvantages in the use of a two-package type of wash primer: namely, in the transportation of the acid and pigmented base in separate containers, the mixing at the time of application, also the short stability life of the mixed product, a stable one-package wash primer was developed in January 1946 and offered to a number of paint companies for experimentation. This primer is a modified polyvinyl butyral solution containing approximately 12 per cent solids. It is claimed that this primer offers advantages over the two-package primer in the latitude allowed in pigmentation, and its greater stability characteristic permits its satisfactory use in a dip tank. It is slightly inferior to the two-package primer in adhesive property and its ability to resist rust creep.

A series of tests were conducted by one signal equipment manufacturer on an alkyd paint system consisting of one coat of zinc chromate and one coat of aluminum paint applied over a two-package type wash primer and over a one-package type wash primer. Both types of wash primers were effective in retarding rust creepage on cross-hatched portions of test panels partially immersed in salt water, also in fresh water, for a period of 600 hours. The tests showed that both types of wash primers were effective in retarding corrosion and rust creepage under an alkyd paint system. However, the two-package wash primer was more effective against rust creepage and it possessed superior adhesive qualities. Both types of wash primers, when used with paint coatings, showed excellent resistance to blistering and peeling. Panels not treated with wash primers, but with the same alkyd type zinc chromate and aluminum finish coats, were noticeably blistered after 600 hours partial immersion in salt water and also in fresh water.

Another series of tests of wash primers is being conducted by a second signal equipment manufacturer. These tests include the application of one coat of other paint primers as follows: wash primer and alkyd zinc chromate iron oxide primer; wash primer and alkyd red lead primer; wash primer and alkyd zinc chromate iron oxide primer followed by one coat of enamel and baked 3 hours at 375 deg. F. These tests have not progressed sufficiently to permit any conclusions at this time. A previous test of 14 months' duration indicated that a wash primer may be beneficial under high bake enamels without the use of a standard inhibitive primer between wash primer and top coat. This system showed no rust creepage away from scratches and the surface was without undue deterioration. In comparison, panels finished only with alkyd zinc chromate iron oxide primer followed with one coat of high bake enamel showed serious deterioration at the scratches and on the over-all surface.

Tests of wash primers on navy ship bottoms over a 6-year period are among the longest on record, and results for this length of time are reported as very

satisfactory. Wash primers are a new and rapidly expanding development which holds promise for valuable advances in the protection of metal surfaces against corrosion.

In conclusion, it should be understood that maximum benefits may be obtained from this method of treatment only when applied to clean metal surfaces such as can be expected under controlled shop and manufacturing conditions.

Action Recommended

Acceptance as information.

PREPARATION OF ALUMINUM SURFACES FOR PAINTING

Aluminum, like steel and iron, can be painted successfully if the surface is properly treated prior to painting. An understanding of aluminum surface conditions is necessary in order to select the proper method of surface treatment. The type of pigments used in the painting of aluminum is also important, and special consideration in their selection is necessary for some applications.

Unlike steel and iron, aluminum does not rust nor is mill scale ever present on its surface. The surface of aluminum, on contact with the air, becomes rapidly oxidized; the degree of oxidation, and resultant oxide film thickness, increases with the length of exposure. Another condition, incurred during the manufacturing processes, is that the surface of the aluminum becomes contaminated with a very thin film of oil or grease. This oily condition is particularly evident on rolled sheet aluminum due to the necessary use of light oil or oil emulsion on the metal as it passes through the rolling mill.

The oxide film condition is desirable when paint coats are to be applied. The film is tightly adherent to the metal, is relatively inert, and provides an excellent base for subsequent paint coats. Surface treatment is often provided to increase the oxide film thickness and so increase its efficiency to hold paint.

The oil and grease surface condition is not desirable if paint is to be applied and it must be removed. This may be accomplished by exposing the aluminum product to the weather for a month or so. If, however, outdoor exposure is impractical because of time or space, some type of surface treatment must be employed.

A type of treatment sometimes used is surface roughening. This is done by sand-blasting, scratch-brushing, or by the use of other abrasives. Usually this treatment is confined to the cleaning of sand castings, some die castings, and heavy structural sections. It should not be used on light sheet aluminum because of a tendency to warp the metal. Any form of surface roughening tends to destroy the natural oxide film and so reduces its adhesive quality for subsequent paint coatings. Because of these undesirable features, surface roughening is not recommended unless it is followed by a chemical treatment.

One simple form of chemical treatment involves the use of a solvent which may be applied by swabbing, or by actual immersion of the article in a dip tank. Following either method the surface must be dried by wiping with a clean cloth. This type of treatment does not insure an absolutely clean surface

as a thin film of grease usually remains on the surface as the solvent evaporates. This grease film can be removed by heating. A more desirable form of solvent cleaning is the solvent vapor degreasing method. This treatment which overcomes many of the objectionable features of ordinary solvent cleaning has proven adequate in many instances. The solvent cleaning methods just described may be used satisfactorily where severe conditions of service are not to be encountered. For more rigid conditions of service a chemical treatment is recommended.

There are a number of simple chemical treatments available which employ a dilute aqueous solution of phosphoric acid. These solutions usually contain alcohol or other organic solvents, and sometimes chromates, in addition to phosphoric acid. Apparently they cause a thin layer of aluminum phosphate to form on the surface of the metal. This film which is quite inert, acts to protect the aluminum and at the same time provides a satisfactory medium for paint adhesion. Inhibited alkaline cleaners of the sodium phosphate type are sometimes employed, but their use must be followed by a treatment with dilute chromic acid or phosphoric acid, of about 5 per cent concentration, and a final water rinse. Uninhibited alkaline cleaners, because of their corrosive action, must not be used. The phosphoric acid chemical treatment while quite satisfactory in many instances, has these limitations: it is inconvenient to use in freezing weather; it will wash off in the rain, if left unpainted; and under certain conditions thick deposits of phosphate may form thereby affecting its adhesive qualities. Some of these deficiencies are overcome by a wash primer type of treatment.

A wash primer known as a two-package type consists of polyvinyl butyral resin mixed with insoluble zinc chromate combined with suitable solvents which are mixed with an acid diluent composed of phosphoric acid mixed with suitable solvents just prior to their use. This treatment causes a thin resinous film to be firmly attached to the surface of the aluminum which in addition to providing excellent corrosion resistance also furnishes a desirable base to which subsequent paint coats may be applied. It has some disadvantages in that it must be used within 8 hours after mixing and it is furnished in two separate packages. Another wash primer, furnished in one package, has been developed to overcome the objection to the short stability life of the two-package type. This primer has shown excellent results, but its use is not as extensive as is the two-package type. These primers may be applied successfully in freezing weather and they may also be applied over damp surfaces. The usual surface cleanliness of the metal must also be observed before applying wash primers.

In addition to the several treatments previously described there are also available hot chemical treatments which have desirable characteristics. The time of processing is materially reduced and the entire operation of cleaning and painting can be speeded up. Treatments of this type usually require rather extensive equipment such as dip or spray tanks, a conveyor line, drying ovens, etc. The treatment is applied at a temperature of 140 to 160 deg. F. The parts to be treated should be precleaned by vapor degreasing or by means of a hot inhibited alkaline dip followed by a hot water rinse.

There are several proprietary processes of this type which are effective. These treatments are multiple-step processes involving a preliminary cleaning and rinse, chemical treatment, rinse, and finally an acidulated rinse followed by forced drying. A visible coating is formed which offers good adhesion for

paint coatings. The processes may be carried out in dip tanks or by spraying in special compartments. The latter method is often preferred because of its greater speed and effectiveness. It is also better adapted to streamlined operation, since the parts to be treated can be placed on a chain conveyor and quickly carried through the entire cycle; in most cases 30 to 60 seconds is sufficient time for each stage of the process. While still on the conveyor, the parts proceed to the paint spray booth for painting.

Previous mention was made that it is sometimes desirable to intentionally increase the natural oxide film on an aluminum surface. This is accomplished by immersing the aluminum in a solution of chromic or sulphuric acid and passing an electric current through the cell, using the aluminum as the anode and the vessel containing the electrolyte as the cathode. This form of treatment is referred to as an "anodic treatment." Its use involves considerable equipment and it is also quite expensive.

One important thing to remember is that, regardless of the cleaning method employed, the surface of the aluminum must be thoroughly dry before paint is applied. Aluminum alloy castings should always be dried by heating. The surface also should be free from oil or grease and, in this connection, a minimum amount of handling is essential.

The type of surface preparation to be used is determined by the character of the metal, the type of the completed structure, and the conditions to which it will be exposed in service. Surfaces, including joints, which will be concealed in the completed structure should receive extra attention; these parts can be effectively protected by the application of a primer paint containing zinc chromate.

Action Recommended

Acceptance as information.

A.A.R. SIGNAL SECTION SPECIFICATION 259-52.

ALUMINUM PAINT (READY-MIXED)

1. *Purpose.*

(a) This specification is for the purpose of providing for a ready-mixed aluminum paint applicable for use on metal and masonry surfaces. It sets forth specific detail requirements representing modern signal practice recommended for the painting of new installations and for the repainting of existing installations when general renewal or repainting becomes desirable.

2. *Specifications.*

(a) Specifications referred to in the body of this specification form an essential part hereof.

3. *Tender.*

(a) The tender shall be for a product meeting the requirements of this specification in its entirety.

4. *Purchaser's order requirements.*

(a) The following additional requirements will be shown on the Purchaser's order:

1. Size and kind of containers.
2. Inspection and tests as required.
3. Alternate requisites as required.

5. *Alternates.*

(a) The provisions contained in the alternate requisites section of this specification form a part hereof only when substituted by Purchaser's order for the provisions contained in this specification.

6. *Material and workmanship.*

(a) Material and workmanship shall be first-class in every respect.

7. *Requirements.*

(a) General.

1. The paint shall be made by mixing aluminum pigment with a suitable vehicle.
2. The paint shall be suitable for brush or spray application.
3. The paint shall be of brushing consistency in the packaged condition and shall be such that when thinned in accordance with the recommendation of the Manufacturer of the paint, it shall be suitable for spraying. *R-7-a-3.

* Alternate requisites section.

7. Requirements.—Continued.

(b) Pigment.

1. The pigment shall consist of commercially pure aluminum in the form of fine flakes uniformly dispersed in mineral spirits to form a paste which shall be in accordance with the requirements of Federal Specification TT-A-468a, Type II, Class B, dated October 7, 1949. *R-7-b-1.

(c) Vehicle.

1. The vehicle shall consist of a phenolic resin base varnish of the long oil type and shall conform to the following requirements (*R-7-c-1):

(a) Phenolic resin content: 100 per cent (based on solids content).

(b) Oil: Shall be a suitable vegetable drying oil as is necessary to meet the requirements of this specification.

(c) Thinner: Shall be free from toxic hydrocarbons, such as benzol or chlorinated hydrocarbons.

(d) Driers: The vehicle shall be free from lead, manganese, calcium or zinc driers.

(e) Rosin or rosin derivatives content: None.

(f) Clarity: Clear, transparent, free from sediment and suspended matter when examined by transmitted light.

(g) Viscosity: Between 0.65 and 1.25 poises at 77 deg. F., corresponding to Tubes B to E of the Gardner-Holdt Air Bubble Viscometer.

(h) Flash point: Not less than 86 deg. F. in a closed cup tester.

(i) Non-volatile matter: Not less than 50 per cent, by weight, of non-volatile oils and resins.

(j) Elasticity and toughness: Shall pass a 100 per cent Kauri Reduction Test.

(k) Skinning: None after 48 hours in a three-fourths filled, tightly closed container.

(l) Gas and draft tests: Shall pass satisfactorily.

(m) Water immersion resistance: Flow out films on No. 28 gage tin plate panels, air-dried 72 hours, shall withstand immersion in cold water for 96 hours and in hot water (167 deg. F.) for 6 hours without whitening, dulling, checking, blistering or showing other serious defect.

(n) Alkali and acid immersion resistance: Films applied to test tubes (dimensions 6 in. by 1 in.) by immersion in varnish to a depth of 4 in. and dried in an inverted position for 72 hours shall show no whitening, dulling, or visible attack when immersed to a depth of 2 inches in a 5 per cent solution of sodium hydroxide for 6 hours (at 68 deg. F.) and (a separate similar film) in a

* Alternate requisites section.

7. *Requirements.*—Continued.

4 per cent solution of acetic acid for 24 hours (at 68 deg. F.).

(o) Gasoline immersion resistance: A flow out film on a No. 28 gage tin plate panel, air-dried 48 hours, shall be immersed in straight run gasoline for 48 hours. After subsequent air drying for 2 hours, the film shall show no whitening, dulling, or visible attack.

(d) Composition.

1. The paint shall meet the following requirements as to composition:

(a) Pigment (aluminum pigment flakes).

14 per cent of total weight of paint, minimum.

Total impurities (mica, filler and other adulterants): None.

Aluminum flakes retained on No. 325 mesh sieve: 1 per cent of total weight of pigment, maximum.

(b) Vehicle.

86 per cent of total weight of paint, maximum.

Non-volatile matter: 46 per cent of total weight of vehicle, minimum.

Volatile thinner: 54 per cent of total weight of vehicle, maximum.

(c) Paint.

8 lbs. per gallon, minimum.

(e) Packaging properties.

1. The paint, as received, shall show no objectionable settling and the pigment shall be readily dispersed by moderate stirring. The resulting paint shall be smooth and uniform in appearance, free from skins or coarse particles.

(f) Appearance.

1. The paint, when flowed on a clean glass panel, supported at an angle of 45 deg., and then allowed to dry, protected from all drafts, for 24 hours at room temperature (68 deg. to 86 deg. F.), shall produce a film comparable in smoothness, color, luster, and opacity to that of a similar film applied at the same time and in the same manner, using a standard comparison paint. The comparison standard shall be prepared by freshly mixing four ounces of aluminum paste meeting Federal Specification TT-A-468a, Type II, Class B, with one pint of phenolic resin base varnish vehicle meeting the requirements of section 7-c-1 of this specification.

(g) Skinning.

1. None, after 48 hours in a three-fourths filled, tightly closed container.

(h) Leafing.

1. Shall show a minimum leaf of 40 per cent.

7. *Requirements.*—Continued.(i) *Stability.*

1. After storage in a full, tightly closed container, at room temperature for 30 days, the paint shall show no skinning, thickening, curdling, jelling or settling of pigment that cannot be easily dispersed by moderate stirring and shall also pass the requirements for leafing as specified in section 7-h-1.

2. After 30 days storage, the filled container shall show no gas pressure.

(j) *Moisture content.*

1. The paint, when received, shall contain not more than 0.1 per cent of water by weight.

(k) *Drying time.*

1. When applied to a metal panel and allowed to air-dry in a vertical position, the paint shall set-to-touch in not less than 1 hour nor more than 4 hours at 86 deg. F. and shall dry hard and tough within 24 hours at 86 deg. F.

(l) *Viscosity.*

1. The paint, when received in brushing consistency, shall show a viscosity of between 30 and 45 seconds as determined by a No. 4 Ford Cup at 77 deg. F.

(m) *Elasticity and toughness.*

1. The paint shall pass a 100 per cent Kauri Reduction Test at 77 deg. F., based on vehicle solids (not paint solids). The bent panel shall be examined by a 10X glass to determine cracking of film.

8. *Application.*

(a) Application of aluminum paint (ready-mixed) shall be in accordance with Specification 120, Manual Part 110.

9. *Tests.*

(a) Tests may be made at point of production, or on samples submitted and may also be made at destination.

(b) Manufacturer shall give the Purchaser sufficient notice of time when the material or product will be ready for testing.

(c) Manufacturer shall provide, at point of production, apparatus and labor for making required tests under supervision of the Purchaser.

(d) If tests are to be made at point of production, it shall be so stated on Purchaser's order. The Purchaser shall indicate which of the tests herein specified are to be made and what portion of the material or product shall be tested.

(e) Tests required in sections 7-c to 7-m, inclusive, except as otherwise specified, shall be conducted in accordance with the methods described in Federal Specification TT-P-141b, as follows:

9. Tests.—Continued.

Test for	Method of testing as shown in Fed. Spec. TT-P-141b
Driers.....	723.1
Rosin or rosin derivatives.....	503.1
Viscosity (vehicle).....	427.1
Flash point.....	429.1
Non-volatile matter.....	405.3
Elasticity and toughness (vehicle).....	415.1
Skinning.....	414.1
Gas test.....	416.1
Draft test.....	417.1
Water immersion resistance.....	601.1
Alkali and acid immersion resistance.....	601.1
Gasoline immersion resistance.....	601.1
Pigment content.....	402.1
Non-volatile vehicle content.....	405.3
Weight per gallon.....	401.1
Working properties.....	454.1
Leafing (10 minute examination).....	445.1
Stability.....	414.2
Moisture content.....	408.1
Drying time.....	406.2
Viscosity (paint).....	428.2
Elasticity and toughness (paint).....	415.1

10. Inspection.

(a) The product furnished under this specification may be accepted upon Manufacturer's certificates of guarantee insuring that it is in accordance with the specification. If on arrival at destination the product is found not to meet the requirements of the specification it may be rejected and the Manufacturer, upon request, shall advise the Purchaser what disposition is to be made of the rejected product. Manufacturer shall pay all freight charges.

11. Containers.

(a) Product will be furnished in 1 quart, 1 gallon and 5 gallon containers, or in drums, as specified by the Purchaser.

12. Packing.

(a) Product shall be so assembled or packed as to permit convenient handling and to protect against loss or damage during shipment.

13. Marking.

(a) Purchaser's order, requisition and package number, name of Consignor, and name and address of Consignee, shall be plainly marked on outside of packages and on tags attached to loose pieces.

13. *Marking.*—Continued.

(b) Detail list of loose pieces, packages and their contents shall be furnished for each shipment. Where carload shipments are made, routing and car identification shall be shown.

14. *Warranty.*

(a) Manufacturer shall warrant the product covered by this specification to be free from defects in material and workmanship under ordinary use and service, his obligation under this warranty being limited to manufacturing, at point of production, any part or parts to replace those which shall be found defective within 1 year after shipment to the Purchaser. This warranty shall not apply to any product which has been subjected to misuse, negligence or accident.

Alternate requisites.

R-7-a-3.

The paint shall be furnished in proper consistency for application by spraying.

R-7-b-1.

The pigment shall consist of finely divided aluminum powder, and shall meet the requirements for coarse particles and leafing of Federal Specification TT-A-468a, Type I, Class B, dated October 7, 1949.

R-7-c-1.

The vehicle shall consist ofand shall conform to the following requirements:

- (a)
- (b)
- (c)

Action Recommended

Acceptance for submission to letter ballot.

(Revision of A.A.R. Signal Section Specification 13-39)
A.A.R. SIGNAL SECTION SPECIFICATION 13-52.

HARD FIBRE

1. *Purpose.*

(a) This specification is for the purpose of providing for bone grade vulcanized fibre to be used as electrical insulation on rail joints, switch rods, gage plates, ball studs, pipe lines and similar fittings. It sets forth specific detail requirements representing modern signal practice recommended for new installations and for replacement on existing installations when general renewal or replacement becomes desirable.

2. *Requisites and specifications.*

(a) Requisites and specifications referred to in the body of this specification form an essential part hereof.

3. *Tender.*

(a) The tender shall be for a product meeting the requirements of this specification in its entirety.

4. *Purchaser's order requirements.*

(a) The following additional requirements will be shown on the Purchaser's order:

1. Specify if for fabrication of head and base pieces for insulated rail joints.
2. Inspection and tests as required.

5. *Material and workmanship.*

(a) Material and workmanship shall be first-class in every respect.

6. *Requirements.*

(a) Sheets, rods and tubes.

1. The fibre in the form of sheets, rods and tubes, shall be in accordance with A.S.T.M. current Specification D 710, Bone Grade, except as follows:

(a) Density. Shall be not less than 1.35 grams per cu. cm.

(b) Compressive strength.

1. When sheet fibre is tested for compressive strength in accordance with method of test as

6. *Requirements.*—Continued.

described in section 7-a-1, the depth of depression shall not exceed the following values:

Specified thickness, in.	Mean depression, in.
$\frac{1}{8}$	0.023
$\frac{3}{16}$	0.028
$\frac{1}{4}$	0.036
$\frac{3}{8}$	0.050

2. In case of dispute, new test pieces shall be conditioned in accordance with A.S.T.M. current Specification D 619 and test repeated.

(c) Water absorption. When the fibre is tested in accordance with method of test as described in section 7-b-1, the increase in weight of sheet fibre due to water absorption shall not exceed 0.67 gram.

(d) Thickness tolerances. Thickness of sheet fibre for use in the fabrication of head and base pieces for insulated rail joints, where the angle bar follows the contour of and forms a bearing under the rail base, shall be within the following limits:

Specified thickness, in.	Maximum thickness, in.	Minimum thickness, in.
$\frac{1}{8}$ (0.125)	0.133	0.123
$\frac{3}{16}$ (0.187)	0.195	0.185

(b) Fabricated fibre parts.

1. Fabricated fibre parts for track insulation shall be in accordance with Requisites for Fabricated Fibre Parts for Track Insulation, Manual Part

7. *Methods of tests.*

(a) Compression test for sheet material.

1. A standard testing machine shall be used and the load applied through a metal tup $\frac{1}{2}$ in. by $\frac{1}{2}$ in. with corners rounded to $\frac{1}{16}$ in. radius, arranged in such manner as to insure an equal bearing of the test sample over the entire surface of the tup. A test piece 1 in. by 1 in. by the thickness shall be placed without conditioning under an initial load of 100 lbs. and the zero reading taken. A load of 5,000 lbs. shall then be applied. The depth of depression in inches shall be measured by the mean reading of two suitable measuring and indicating appliances mounted on the upper crushing head of machine, the samples being supported on the lower crushing head.

(b) Water absorption test for sheet material.

1. A test piece 1 in. by 1 in. by the thickness shall be weighed and placed in water at room temperature. It shall be removed from the water at the expiration of 6 hours, the

7. *Methods of tests.*—Continued.

excess moisture wiped off and the test piece weighed immediately. The increase in weight shall be an indication of the water absorption in grams.

8. *Inspection.*

(a) Purchaser may inspect the material or product at all stages of manufacture.

(b) Purchaser may inspect the completed product at point of production to determine that the requirements of this specification have been met.

(c) If product has not been accepted at point of production and if, upon arrival at destination, it does not meet the requirements of this specification, other than dimensional, it may be rejected, and the Manufacturer, upon request, shall advise the Purchaser what disposition is to be made of the rejected product. Manufacturer shall pay all freight charges.

(d) If Purchaser is to make inspection at point of production it shall be so stated on Purchaser's order.

9. *Tests.*

(a) Tests may be made at point of production, or on samples submitted, and may also be made at destination.

(b) Manufacturer shall give the Purchaser sufficient notice of time when the material or product will be ready for testing.

(c) Manufacturer shall provide, at point of production, apparatus and labor for making required tests under supervision of the Purchaser.

(d) If tests are to be made at point of production, it shall be so stated on Purchaser's order. The Purchaser shall indicate which of the tests herein specified are to be made and what portion of the material or product shall be tested.

(e) Testing methods and conditioning for test shall be in accordance with A.S.T.M. current Specification D 619 unless otherwise specified herein.

10. *Samples for tests.*

(a) Three samples shall be selected at random by the Purchaser or his representative from each lot, run or part thereof of 25 sheets of the same specified thickness or 500 fabricated pieces of the same specified thickness. Test pieces of the required size shall be sawed from each sample selected and shall be free from burrs. If any of the samples fail to meet the requirements of any of the specified tests, the tests shall be repeated on two additional samples selected at random from different pieces of the same lot. Failure of one or both of these samples to meet the requirements of the tests will be sufficient cause for rejection of the lot.

11. *Packing.*

(a) Product shall be so assembled or packed as to permit convenient handling and to protect against loss or damage during shipment.

12. *Marking.*

(a) Purchaser's order, requisition and package number, name of Consignor, and name and address of Consignee, shall be plainly marked on outside of packages and on tags attached to loose pieces.

(b) Detail list of loose pieces, packages and their contents shall be furnished for each shipment. Where carload shipments are made, routing and car identification shall be shown.

13. *Warranty.*

(a) Manufacturer shall warrant the product covered by this specification to be free from defects in material and workmanship under ordinary use and service, his obligation under this warranty being limited to manufacturing, at point of production, any part or parts to replace those which shall be found defective within 90 days after shipment to the Purchaser. This warranty shall not apply to any product which shall have been repaired or altered in any way by anyone other than the Manufacturer thereof, so as to affect, in the Manufacturer's judgment, its proper functioning or reliability, or which has been subjected to misuse, negligence or accident.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Specification 13-39—Hard Fibre, Manual Part 58.

A.A.R. SIGNAL SECTION REQUISITES.

FABRICATED FIBRE PARTS FOR TRACK INSULATION

1952

1. *Purpose.*

(a) These requisites are for the purpose of setting forth the recommended general requirements and permissible variations in dimensions and contours in the fabrication of finished fibre parts for track insulation. They set forth specific detail requirements representing modern signal practice recommended for new installations and for replacement of existing installations when general renewal or replacement becomes desirable.

2. *General.*

(a) All fabricated parts shall be of hard fibre meeting the requirements of Specification 13, Manual Part 58.

(b) Fabricated parts, except head pieces, base pieces and bushings, shall have tolerances of thickness in accordance with A.S.T.M. current Specification D 710.

(c) Edges shall be free from burrs and other defects.

3. *Head and base pieces.*

(a) Head and base pieces for use in insulated rail joints where the angle bar follows the contour of and forms a bearing under rail base, shall meet the following requirements:

1. Thickness of head and base pieces shall be within the following limits:

Specified thickness, in.	Maximum thickness, in.	Minimum thickness, in.
$\frac{1}{8}$ (0.125)	0.133	0.123
$\frac{3}{16}$ (0.187)	0.195	0.185

2. *Base pieces (Fig. 1).*

(a) Radius of bend at crotch (detail R, Fig. 1) at time of shipment shall be as shown on Purchaser's drawing plus $\frac{1}{32}$ in. minus zero.

(b) Angle of bend (detail B, Fig. 1) at time of shipment shall be not greater than 25 deg.

(c) Length of bottom or base leg (detail C, Fig. 1) and of vertical top-extension (detail D, Fig. 1) shall be as shown on Purchaser's drawing plus or minus $\frac{1}{8}$ in.

(d) Over-all length shall be as shown on Purchaser's drawing plus or minus $\frac{1}{8}$ in.

3. *Head pieces, non-armored (Fig. 2).*

(a) Angle of bend (detail A, Fig. 2) at time of shipment shall be as shown on Purchaser's drawing plus 4 deg. minus 8 deg.

3. *Head and base pieces.*—Continued.

(b) Length of each leg (details B and C, Fig. 2) shall be as shown on Purchaser's drawing plus or minus $\frac{1}{16}$ in.

(c) Over-all length shall be as shown on Purchaser's drawing plus or minus $\frac{1}{8}$ in.

(d) Location of bolt apertures shall be:

1. Longitudinally as shown on Purchaser's drawing plus or minus $\frac{1}{16}$ in.

2. Vertically as shown on Purchaser's drawing plus $\frac{1}{8}$ in. minus zero.

4. *Head pieces, armored.*

(a) Angles of bends and lengths of angular surfaces shall be such as to accurately and snugly fit the contour of joint bar.

(b) Over-all length shall be as shown on Purchaser's drawing plus or minus $\frac{1}{16}$ in.

(c) Location of bolt apertures shall be:

1. Longitudinally as shown on Purchaser's drawing plus or minus $\frac{1}{32}$ in.

2. Vertically as shown on Purchaser's drawing plus or minus $\frac{1}{16}$ in.

(d) Diameter of bolt apertures shall be as shown on Purchaser's drawing plus $\frac{1}{32}$ in. minus zero.

4. *Bushings.*

(a) Inside and outside diameters shall be as shown on Purchaser's drawing plus or minus 0.0075 in.

(b) Length shall be as shown on Purchaser's drawing plus or minus $\frac{1}{32}$ in.

(c) Variations in wall thickness due to eccentricity shall not exceed 0.015 in.

5. *Washer plates for insulated rail joints and flat pieces for switch rods, gage plates and pipe insulation.*

(a) Over-all length and width shall be as shown on Purchaser's drawing plus or minus $\frac{1}{16}$ in.

(b) Location of holes shall be as shown on Purchaser's drawing plus or minus $\frac{1}{32}$ in.

(c) Diameter of holes shall be as shown on Purchaser's drawing plus $\frac{1}{32}$ in. minus zero.

6. *End posts.*

(a) End posts for non-armored insulated rail joints shall not, in contour, exceed the contour of the proper rail section at any point but may come within the rail section contour by not more than $\frac{1}{32}$ in. except at the top of rail where end post may come within the rail section by not more than $\frac{1}{8}$ in., and except at sides of head, where end post may come within the rail section by not more than $\frac{1}{16}$ in.

6. *End posts.*—Continued.

(b) End posts for armored insulated rail joints shall be in accordance with Requisite 6-a in all respects except that they shall extend beyond the contour of rail section at underside of head and upper portion of web only, by not less than $\frac{1}{16}$ in. and by not more than $\frac{3}{32}$ in.

7. *Waterproofing.*

(a) An approved waterproofing treatment shall be given to all parts.

8. *Marking.*

(a) Each piece of fibre, except bushing, shall be clearly marked with Manufacturer's name or trade-mark, and in case of insulated rail joint parts, the rail section for which it is designed.

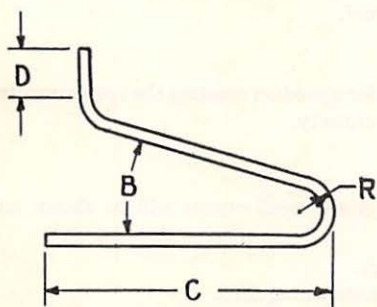


Fig. 1

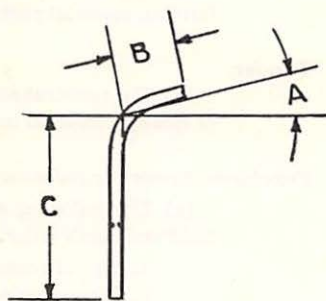


Fig. 2

Action Recommended

Acceptance for submission to letter ballot.

(Revision of A.A.R. Signal Section Specification 77-41)
A.A.R. SIGNAL SECTION SPECIFICATION 77-52.

IMPEDANCE BOND COMPOUND

1. *Purpose.*

(a) This specification is for the purpose of providing for a compound for use in impedance bonds as an insulating and a cooling medium. It sets forth specific detail requirements representing modern signal practice recommended for new installations and for replacement on existing installations when general renewal or replacement becomes desirable.

2. *Specifications.*

(a) Specifications referred to in the body of this specification form an essential part hereof.

3. *Tender.*

(a) The tender shall be for a product meeting the requirements of this specification in its entirety.

4. *Purchaser's order requirements.*

(a) The following additional requirements will be shown on the Purchaser's order:

1. Size of containers.
2. Inspection and tests as required.

5. *Material and workmanship.*

(a) Material and workmanship shall be first-class in every respect.

6. *Requirements.*

(a) The product shall result from the distillation of petroleum and shall be free from crystalline wax, water, acid, alkali, and other impurities which will injuriously affect its insulating properties.

(b) The product shall be in accordance with the following requirements:

1. Specific gravity: between 27 deg. Baume (0.891) and 30 deg. Baume (0.875).
2. Flash point: 375 deg. F. minimum.
3. Melting point: between 120 and 135 deg. F.
4. Free water: none.
5. Total acid number: neutralization value 0.10 maximum.
6. Corrosion of copper: none.
7. Dielectric strength: 15 kv. minimum at 150 deg. F.

7. Inspection.

(a) Purchaser may inspect the material or product at all stages of manufacture.

(b) Purchaser may inspect the completed product to determine that the requirements of this specification have been met.

(c) If product has not been accepted at point of production and if, upon arrival at destination, it does not meet the requirements of this specification, it may be rejected, and the Manufacturer, upon request, shall advise the Purchaser what disposition is to be made of the rejected product. Manufacturer shall pay all freight charges.

(d) If Purchaser is to make inspection at point of production it shall be so stated on Purchaser's order.

8. Tests.

(a) Tests may be made at point of production, or on samples submitted, and may also be made at destination.

(b) Manufacturer shall give the Purchaser sufficient notice of time when material or product will be ready for testing.

(c) Manufacturer shall provide, at point of production, apparatus and labor for making required tests under supervision of the Purchaser.

(d) If tests are to be made at point of production, it shall be so stated on Purchaser's order. The Purchaser shall indicate which of the tests herein specified are to be made and what portion of the material or product shall be tested.

(e) All tests shall be made in accordance with current A.S.T.M. methods:

1. Sampling—A.S.T.M. D 270.
2. Specific gravity—A.S.T.M. D 70.
3. Flash point—A.S.T.M. D 92.
4. Melting point—A.S.T.M. D 127.
5. Water content—A.S.T.M. D 95.
6. Neutralization value—A.S.T.M. D 974 or D 664.
7. Corrosion—A.S.T.M. D 130.
8. Dielectric strength—A.S.T.M. D 176.

9. Containers.

(a) The product shall be furnished in non-returnable metal containers.

(b) Purchaser shall specify size of containers.

10. Packing.

(a) Product shall be so assembled or packed as to permit convenient handling and to protect against loss or damage during shipment.

11. *Marking.*

(a) Purchaser's order, requisition and package number, name of Consignor, and name and address of Consignee, shall be plainly marked on outside of each package.

(b) Detail list of packages and their contents shall be furnished for each shipment. Where carload shipments are made, routing and car identification shall be shown.

12. *Warranty.*

(a) Manufacturer shall warrant the product covered by this specification to be free from defects in material and workmanship under ordinary use and service, his obligation under this warranty being limited to manufacturing, at point of production, any part or parts to replace those which shall be found defective within 90 days after shipment to the Purchaser. This warranty shall not apply to any product which has been subjected to misuse, negligence or accident.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Specification 77-41—Insulating Compound for Use in Impedance Bonds, Manual Part 111.

(Revision of Specifications for Various Types of Non-Ferrous Metals and Alloys)

SPECIFICATIONS FOR VARIOUS TYPES OF
NON-FERROUS METALS AND ALLOYS

1952

The recommended specifications for various types of non-ferrous metals and alloys shall be the current specifications of the American Society for Testing Materials, for application as follows:

1. Binding posts and screws with cold upset heads and rolled threads:
 - (a) B 98—Copper-Silicon Alloy Rods, Bars and Shapes, Alloy B, extra-hard, bolt temper.
 - (b) B 164—Nickel-Copper Alloy Rods and Bars, Class A, cold-drawn.
2. Binding posts and screws, machine-cut:
 - (a) B 98—Copper-Silicon Alloy Rods, Bars and Shapes, Alloy D, hard temper.
 - (b) B 140—Leaded Red Brass (Hardware Bronze) Rods, Bars and Shapes, Alloy B, half-hard temper.
 - (c) B 164—Nickel-Copper Alloy Rods and Bars, Class B, cold-drawn.
3. Nuts for binding posts and general purposes:
 - (a) B 16—Free-Cutting Brass Rod and Bar for Use in Screw Machines, half-hard temper.
4. Machine-cut screws other than for use as binding posts:
 - (a) B 16—Free-Cutting Brass Rod and Bar for Use in Screw Machines, half-hard temper. (Not to be used for securing vital parts.)
 - (b) B 98—Copper-Silicon Alloy Rods, Bars and Shapes, Alloy D, hard temper.
 - (c) B 139—Phosphor Bronze Rods, Bars and Shapes, alloy as required. (For screws, shafts, bushings, trunnions and other structural parts.)
 - (d) B 140—Leaded Red Brass (Hardware Bronze) Rods, Bars and Shapes, Alloy B, half-hard temper.
 - (e) B 164—Nickel-Copper Alloy Rods and Bars, Class B, cold-drawn.
5. Commercial screws with cold upset head and rolled threads:
 - (a) B 134—Brass Wire, Alloy No. 7, eighth hard temper.
6. Washers for use on binding posts:
 - (a) B 152—Copper Sheet, Strip, and Plate, Type ETP cold-rolled hard temper.

7. Structural parts and general purpose washers:

- (a) B 16—Free-Cutting Brass Rod and Bar for Use in Screw Machines, half-hard temper. (Not to be used for securing vital parts.)
- (b) B 36—Brass Plate, Sheet and Strip, alloy number and temper as required.
- (c) B 97—Copper-Silicon Alloy Plate, Sheet and Strip for General Purposes, alloy and temper as required.
- (d) B 98—Copper-Silicon Alloy Rods, Bars, and Shapes, Alloy D, hard temper.
- (e) B 103—Phosphor Bronze Plate, Sheet and Strip, alloy and temper as required.
- (f) B 122—Copper-Nickel-Zinc and Copper-Nickel Alloy Plate, Sheet and Strip, alloy number and temper as required.
- (g) B 127—Nickel-Copper Alloy Plate, Sheet, and Strip, finish and temper as required.
- (h) B 135—Seamless Brass Tubes, alloy and temper as required.
- (i) B 139—Phosphor Bronze Rods, Bars and Shapes, alloy as required. (For screws, shafts, bushings, trunnions and other structural parts.)
- (j) B 140—Leaded Red Brass (Hardware Bronze) Bars and Shapes, Alloy B, half-hard temper.
- (k) B 152—Copper Sheet, Strip, and Plate, type and temper as required.
- (l) B 164—Nickel-Copper Alloy Rods and Bars, Class B, cold-drawn.
- (m) B 187—Copper Bus Bars, Rods and Shapes.
- (n) B 194—Beryllium Copper Alloy Plate, Sheet and Strip, temper as required.
- (o) B 196—Beryllium Copper Alloy Rod and Bar, temper as required.
- (p) B 209—Aluminum and Aluminum Alloy Sheet and Plate, alloy number and temper as required.
- (q) B 211—Aluminum and Aluminum-Alloy Bars, Rods and Wire, alloy number and temper as required.

8. Spring contacts and contact springs:

- (a) B 103—Phosphor Bronze Plate, Sheet and Strip, alloy and temper as required.
- (b) B 122—Copper-Nickel-Zinc and Copper-Nickel Alloy Plate, Sheet and Strip, alloy number and temper as required.
- (c) B 162—Nickel Plate, Sheet and Strip, temper as required.
- (d) B 194—Beryllium Copper Alloy Plate, Sheet and Strip, temper as required.

9. Connectors:

- (a) B 152—Copper Sheet, Strip and Plate, Type ETP, temper as required.

10. Coiled springs:

- (a) B 159—Phosphor Bronze Wire, alloy and temper as required.
- (b) B 197—Beryllium Copper Alloy Wire.

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Committee VII—Materials Research

11. Die castings:

- (a) B 85—Aluminum Base Alloy Die Castings, alloy as required.
- (b) B 86—Zinc Base Alloy Die Castings, alloy number as required.
- (c) B 176—Copper Base (Brass) Alloy Die Castings, alloy as required.

12. Sand castings:

- (a) B 26—Aluminum Base Alloy Sand Castings, alloy and treatment as required.
- (b) Specifications for various Cast Copper Base Alloys can be found in Standard Classification for Cast Copper Base Alloys listed under "Explanatory Note" in B 119.

13. Forgings (for hot forged parts):

- (a) B 124—Copper and Copper Base Alloy Forging Rods, Bars and Shapes, alloy as required.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Specifications for Various Types of Non-Ferrous Metals and Alloys,
Manual Part 220.

(Revision of A.A.R. Signal Section Specification 217-46)
A.A.R. SIGNAL SECTION SPECIFICATION 217-52.

IMPEDANCE BOND OIL

1. *Purpose.*

(a) This specification is for the purpose of providing for an oil for use in impedance bonds as an insulating and a cooling medium. It sets forth specific detail requirements representing modern signal practice recommended for new installations and for replacement on existing installations when general renewal or replacement becomes desirable.

2. *Specifications.*

(a) Specifications referred to in the body of this specification form an essential part hereof.

3. *Tender.*

(a) The tender shall be for a product meeting the requirements of this specification in its entirety.

4. *Purchaser's order requirements.*

(a) The following additional requirements will be shown on the Purchaser's order:

1. Size of containers.
2. Inspection and tests as required.

5. *Material and workmanship.*

(a) Material and workmanship shall be first-class in every respect.

6. *Requirements.*

(a) The product shall be pure mineral oil obtained by fractional distillation of petroleum and shall not contain any substance which will injuriously affect its insulating properties.

(b) The product shall be in accordance with the following requirements:

1. Color: A.S.T.M. No. 3 N.P.A. or lighter, transparent (lemon pale).
2. Flash point: 340 deg. F. minimum.
3. Fire point: 390 deg. F. minimum.
4. Pour point: 5 deg. F. maximum.
5. Viscosity: S.U. at 100 deg. F., 270-375 seconds.
6. Total acid number: neutralization value 0.03 maximum.
7. Mineral acids: (water soluble) nil.
8. Alkali: nil.

6. Requirements—Continued.

9. Free sulphur: nil.
10. Inorganic chlorides and sulphates: nil.
11. Free water: none.
12. Dielectric strength: 10 kv. minimum.

7. Inspection.

(a) Purchaser may inspect the material or product at all stages of manufacture.

(b) Purchaser may inspect the completed product to determine that the requirements of this specification have been met.

(c) If product has not been accepted at point of production and if, upon arrival at destination, it does not meet the requirements of this specification, it may be rejected, and the Manufacturer, upon request, shall advise the Purchaser what disposition is to be made of the rejected product. Manufacturer shall pay all freight charges.

(d) If Purchaser is to make inspection at point of production it shall be so stated on Purchaser's order.

8. Tests.

(a) Tests may be made at point of production, or on samples submitted, and may also be made at destination.

(b) Manufacturer shall give the Purchaser sufficient notice of time when the material or product will be ready for testing.

(c) Manufacturer shall provide, at point of production, apparatus and labor for making required tests under supervision of the Purchaser.

(d) If tests are to be made at point of production, it shall be so stated on Purchaser's order. The Purchaser shall indicate which of the tests herein specified are to be made and what portion of the material or product shall be tested.

(e) All tests shall be made in accordance with current A.S.T.M. methods:

1. Sampling—A.S.T.M. D 923.
2. Color—A.S.T.M. D 155.
3. Flash point and fire point—A.S.T.M. D 92.
4. Pour point—A.S.T.M. D 97.
5. Viscosity—A.S.T.M. D 88.
6. Neutralization value—A.S.T.M. D 974 or D 664.
7. Mineral acid—A.S.T.M. D 117.
8. Alkali—A.S.T.M. D 974 or D 664.
9. Free sulphur—A.S.T.M. D 989.
10. Inorganic chlorides and sulphates—A.S.T.M. D 878.
11. Water content—A.S.T.M. D 95.
12. Dielectric strength—A.S.T.M. D 877.

9. *Containers.*

(a) The product shall be furnished in clean dry containers. Except when furnished in drums, containers shall be provided with a suitable replaceable pour opening cap.

(b) Purchaser shall specify size of containers.

10. *Packing.*

(a) Product shall be so assembled or packed as to permit convenient handling and to protect against loss or damage during shipment.

11. *Marking.*

(a) Purchaser's order, requisition and package number, name of Consignor, and name and address of Consignee, shall be plainly marked on outside of package.

(b) Detail list of packages and their contents shall be furnished for each shipment. Where carload shipments are made, routing and car identification shall be shown.

12. *Warranty.*

(a) Manufacturer shall warrant the product covered by this specification to be free from defects in material and workmanship under ordinary use and service, his obligation under this warranty being limited to manufacturing, at point of production, any part or parts to replace those which shall be found defective within 60 days after shipment to the Purchaser. This warranty shall not apply to any product which has been subjected to misuse, negligence or accident.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter,
in the Manual.

Subject-matter to be Superseded

Specification 217-46—Insulating Oil for Use in Impedance Bonds,
Manual Part 222.

FIELD USES OF RUST PREVENTIVES

(Exclusive of Paint)

The results obtained from the use of various rust preventives depend to a great extent upon local conditions and methods of application, consequently specific recommendations cannot be made regarding the use of any particular product.

Table I indicates classification numbers which have been assigned to various field uses of rust preventives in order to simplify the preparation of Table II.

Table II indicates actual uses reported by some railroads and uses recommended by manufacturers. In this table, reference to various field uses is made by means of the classification numbers given in Table I.

TABLE I

Classification of Field Uses

Classification number	Uses
1	Storage for limited periods.
2	Rail braces and gage plates.
3	Insulated rail joints.
4	Track bond and rail connections.
5	Pipe, rod and bolt threads.
6	Inaccessible portions. (a) Anchor bolts. (b) Signal assembly fastenings. (c) Switch machines. (d) Retarder parts.
7	Metal cases and similar surfaces not accessible for painting.
8	Inside of signal masts.
9	Unpainted surfaces of interlocking machine and parts.

TABLE II

Actual and Manufacturers' Recommended Field Uses

Product	Manufacturer	Actual railroad use reported	Uses recommended by manufacturers
A.A.R. cold compounds Sig. Sec. Spec. 188	Maloney Oil & Mfg. Co., New York, N. Y.	6 (a), 7	
Black oil	Various	1, 2, 3, 5	
Car oil	Various	1	
Chipman Chem. Co. lubricant	Chipman Chem. Co., Chicago, Ill.	2	
Crank case oil	Various	1, 5	

TABLE II—Continued

Product	Manufacturer	Actual railroad use reported	Uses recom- mended by manu- facturers
Duxseal	Johns-Manville Corp., New York, N. Y.	6 (a), 6 (c), 6 (d), 7	
Fibrate water- proofing compound	Sanger Production Co., Rochester, N. Y.	7	
Graphol oil	Graphol Products Co., Brooklyn, N. Y.	9	
Leadolene	Brooks Oil Co., Cleveland, Ohio	2, 3, 4	
Missouri Pacific Spec. R-201	Various	3	
NO-OX-ID "A Special"	Dearborn Chem. Co., Chicago, Ill.	1, 2, 3, 4, 6 (a), 6 (b), 6 (c), 6 (d), 7, 9	1, 2, 3, 4, 5, 6 (a), 6 (b), 6 (c), 6 (d), 7, 8, 9
NO-OX-ID 406	Dearborn Chem. Co., Chicago, Ill.		5, 6 (d), 7, 8, 9
Nox-Rust 200	Nox-Rust Chem. Corp., Chicago, Ill.		1, 2, 4, 5, 9
Nox-Rust 366	Nox-Rust Chem. Corp., Chicago, Ill.		1
Nox-Rust 488	Nox-Rust Chem. Corp., Chicago, Ill.		2, 6 (c), 6 (d)
Oxylin	Ball Chem. Co., Pittsburgh, Pa.	6 (a), 6 (c), 6 (d), 7	
Penetrol	The Flood Co., Hudson, Ohio		1, 3, 5, 6 (b), 6 (c), 6 (d), 7, 8
Preservative oil	Specialty Gulf Refining Co., No address given	2, 3	
Protect coat	Nox-Rust Chem. Corp., Chicago, Ill.		6 (a), 6 (b), 7
Rust preventive	Ball Chem. Co., Pittsburgh, Pa.	1, 9	
Rust proof compound LB	Texas Oil Co., New York, N. Y.		1, 2, 3, 4, 5, 6 (a), 6 (b), 6 (c), 6 (d), 7, 9
Semaphore oil	Various	9	
Slushing oil #75	Houghton Co., Philadelphia, Pa.	5, 9	
Slushing oil #75	Nox-Rust Chem. Corp., Chicago, Ill.	1, 6 (d)	
S/V #908 Flushing	Socony-Vacuum New York, N. Y.	1	

TABLE II—Continued

Product	Manufacturer	Actual railroad use reported	Uses recom- mended by manu- facturers
S/V Product 2305	Socony-Vacuum, New York, N. Y.		3
S/V Sova-Kote 201	Socony-Vacuum, New York, N. Y.		9
S/V Sova-Kote 302	Socony-Vacuum, New York, N. Y.		2, 4, 5, 6 (a), 9
S/V Sova-Kote 601	Socony-Vacuum, New York, N. Y.		1, 2, 4, 5, 6 (b), 6 (c), 6 (d), 7, 8 9
Tectyl 500-11	Freedom-Valvoline Oil Co., Freedom, Pa.		
Tectyl 502-C	Freedom-Valvoline Oil Co., Freedom, Pa.		6 (a), 6 (b), 6 (c), 6 (d)
Texaco #45	Texas Oil Co., New York, N. Y.	5	
Texaco #55	Texas Oil Co., New York, N. Y.	2, 3, 4, 5	
Texaco #965 grease	Texas Oil Co., New York, N. Y.	6 (c)	
Texaco home lubricant	Texas Oil Co., New York, N. Y.	9	
Texaco metal preservative	Texas Oil Co., New York, N. Y.	2, 3, 4	
Texaco rust compound	Texas Oil Co., New York, N. Y.	1	
Track oil NYCS Spec. 1206A, Class 21	Various	1, 3	
X-Rust 400-C	Freedom-Valvoline Oil Co., Freedom, Pa.		7, 8
X-Rust 450	Freedom-Valvoline Oil Co., Freedom, Pa.		2, 3, 4, 9
X-Rust 469-A	Freedom-Valvoline Oil Co., Freedom, Pa.		1, 5
X-Rust 483	Freedom-Valvoline Oil Co., Freedom, Pa.		2, 4

Action Recommended

Acceptance as information.

USE OF STAINLESS STEEL GUY AND MESSENGER STRAND

Supplementing previous reports presented as information at the 1948 and 1949 Annual Meetings*, further investigation develops the following:

A recent check of the use of stainless steel guy and messenger strand revealed that 18 railroads are now using or are considering its use. Three railroads reported stainless steel strand in use for special purposes in the amounts of 155,000 feet, 100,000 feet and 50,000 feet, respectively, and 15 railroads report having various amounts from 1,000 to 5,500 feet each for trial.

Information available indicates that stainless steel is satisfactory for use as guy and messenger strand. It may be particularly desirable at locations where corrosive conditions are present.

Stainless steel strand is preformed for safe handling in the field and can be formed around a mandrel having a diameter eight times that of the strand without fracture or injury.

Stainless steel or bronze clamp and splice fittings are being manufactured and should be used for securing stainless steel guy and messenger strand.

The manufacturer recommends the use of stainless steel A.I.S.I. Type 301 which contains 16 to 18 per cent chromium, 6 to 8 per cent nickel, and 0.08 to 0.20 per cent carbon in the making of guy and messenger strands. This type is preferred because of its characteristics, which are as follows:

1. It work hardens very rapidly in cold drawing which makes it possible to get extremely high tensile strength—235,000 p.s.i. minimum.
2. When hard-drawn it is only slightly magnetic.
3. When stranded it has a relatively low modulus of elasticity.
4. It has excellent corrosion-resisting qualities with high yield and fatigue strengths.

A comparison of the breaking strength of stainless steel, copper-covered steel, galvanized steel, and bronze guy and messenger strand is shown in the following tabulations:

Stainless Steel Guy and Messenger Strand—
Information Submitted by Manufacturer

Size, inches	Number of strands	Minimum breaking strength, lbs.
$\frac{7}{32}$	7	6,300
$\frac{1}{4}$	7	8,500
$\frac{9}{32}$	7	10,700
$\frac{5}{16}$	7	13,200
$\frac{3}{8}$	7	18,000
$\frac{7}{16}$	7	26,000
$\frac{1}{2}$	7	33,700

* A.A.R. Signal Section 1947 Proceedings, Vol. XLV, pp. 263 and 422, and A.A.R. Signal Section 1948 Proceedings, Vol. XLVI, pp. 346 and 470.

Copper-Covered Steel Guy and Messenger Strand—
Per A.A.R. Signal Section Specification 173, Manual Part 69

Size, inches	Number of strands	Minimum breaking load, lbs.	
		High strength	Extra high strength
$\frac{5}{16}$	7	7,750	9,200
$\frac{11}{32}$	7	9,320	11,280
$\frac{3}{8}$	7	11,340	13,800
$\frac{7}{16}$	7	13,860	16,820
$\frac{1}{2}$	7	16,880	20,410

Galvanized Steel Guy and Messenger Strand—
Per A.A.R. Communications Section Specification 1-A-17

Size, inches	Number of strands	Minimum breaking strength, lbs.
$\frac{3}{32}$	7	4,600
$\frac{5}{16}$	7	7,000
$\frac{3}{8}$	7	11,600
$\frac{7}{16}$	7	18,600

Bronze Guy and Messenger Strand—
Per A.A.R. Communications Section Specification 1-A-53

Size, inches	Number of strands	Minimum breaking strength, lbs.
$\frac{5}{16}$	7	7,000
$\frac{3}{8}$	7	10,000
$\frac{15}{32}$	7	16,000

Action Recommended

Acceptance as information.

(Revision of Specification for Signal Colors Exclusive of Signal Glasses)

**SPECIFICATION FOR SIGNAL COLORS EXCLUSIVE OF
SIGNAL GLASSES**

1952

The following colors are recommended for switch targets, interlocking machine levers, semaphore signal blades and similar equipment:

Red —Color No. 1105, Federal Specification TT-C-595
Yellow—Color No. 1310, Federal Specification TT-C-595
Blue —Color No. 1520, Federal Specification TT-C-595
White —Color No. 1755, Federal Specification TT-C-595
Black —Color No. 1775, Federal Specification TT-C-595
Green —Color No. 1445, Federal Specification TT-C-595

Note.—Federal Specification TT-C-595, "Colors; (for) Ready-Mixed Paints" is for sale by the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D. C. (Price \$4.50)

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Specification for Signal Colors Exclusive of Signal Glasses,
Manual Part 273.

COMMITTEE VIII—HIGHWAY GRADE CROSSING PROTECTION

Personnel

W. H. Stilwell, Chairman

H. T. Fleisher, Vice-Chairman

H. A. Appleby	H. C. Sampson
P. H. Foley	E. J. Seybold
A. M. Gilbert	R. H. Smedley
S. B. Higginbottom	W. R. Smylie
J. E. K. Krylow	J. L. Weatherby
S. W. Law	L. S. Werthmuller
B. F. McGowan	A. W. Wilson
H. G. Morgan	H. D. Blake*
P. H. Peters	R. B. Elsworth*
W. F. Price	H. A. Franklin*
L. McNally*	

Signal Section, A.A.R.:

The following outline of work has been assigned:

1. Revision of Manual.
2. Indexing signal literature.
3. Report on noteworthy developments in highway grade crossing protection.
4. Investigate and report on the use of diffusing lenses in electric light units for highway crossing signals to provide a wider range of indication where a long view is not required.
5. Prepare typical location plans for highway grade crossing protection devices.
6. Investigate and report on the durability and methods of maintenance of reflectorized signs.
7. Investigate and report on desirable uniform practice or practices concerning action to be taken by highway users when various types of highway grade crossing protection devices indicate the approach of trains.
8. Investigate and report on methods for preventing unnecessary operation of automatic highway grade crossing protection devices.

The Committee submits for consideration, reports on the following subjects**:

1. Revision and consolidation of Specification 176-41, Manual Part 149 and Specification 209-50, Manual Part 179.

Revision of Signs used in Connection with Manually Protected Railroad-Highway Grade Crossings, and Advance Warning Signs, Manual Part 269.

* Consulting Member.

** Suggestions or criticisms should be submitted in writing to the Chairman of the Committee on or before September 1, 1952.

4. Use of diffusing roundels in electric light units for highway crossing signals to provide a wider range of indication where a long view is not required.

8. Methods for preventing unnecessary operation of automatic highway grade crossing protective devices.

Information

Specifications, etc., of other organizations referred to in the report of this Committee may be procured from the following:

A.I.E.E.—American Institute of Electrical Engineers, 33 W. 39th St., New York 18, N. Y.

A.R.E.A.—American Railway Engineering Association, 59 E. Van Buren St., Chicago 5, Ill.

(Revision and Consolidation of A.A.R. Signal Section Specifications 176-41 and 209-50)
A.A.R. SIGNAL SECTION SPECIFICATION 176-52.

AUTOMATIC HIGHWAY GRADE CROSSING SIGNALS AND DEVICES

General Provisions

1. *Purpose.*

(a) This specification is for the purpose of providing for the installation of automatic highway grade crossing signals and devices. It sets forth specific detail requirements representing modern signal practice recommended for new installations and for the replacement of existing installations when general renewal or replacement becomes desirable.

2. *Details of work.*

(a) The installation shall include the following features:

1. Track to be provided with operating circuits.
2. Power supply.
3. Distributing system:
 - (a) Aerial.
 - (b) Surface.
 - (c) Underground.
4. Foundations.
5. Signals.
6. Gates.
7. Gate operating mechanisms.
8. Bells.
9. Conduits and supports.
10. Wires and cables.
11. Instrument and battery housings.
12. Insulation.
13. Painting.
14. Bonding.
15. Energy for operating gates, signals, track circuits, etc.
16.
17.

3. *Requisites, specifications, drawings and instructions.*

(a) Requisites, specifications, drawings and instructions referred to in the body of this specification form an essential part hereof.

(b) Purchaser shall furnish drawings which should include the following:

1. Track and signal plan drawn to scale showing track and highway with grades and alignments; signals and

Note.—The recommended forms of construction contract, proposal, and bond, will be found in Manual of the American Railway Engineering Assn., under the heading "Uniform General Contract Forms."

3. *Requisites, specifications, drawings and instructions.*—Continued.

switches, designating their normal position and whether interlocked or non-interlocked; location and capacity of existing junction boxes, relay and battery housings, power stations or source, existing and proposed highway crossing protection; pole line or other supports for line wires or aerial cables; kind and condition of ballast and such other physical characteristics or information as is desirable. Drawing....., dated

2. Plan showing any existing circuits that may effect the final circuit arrangement. Drawing, dated

3. Such standards and other drawings as the Purchaser considers desirable. Drawing, dated

(c) Contractor's drawings.

1. Contractor shall furnish with his proposal drawings or references for the apparatus he proposes to furnish, which are not covered by the drawings furnished by the Purchaser.

2. Within days after receipt of the drawings, the Purchaser will indicate any corrections that may be necessary, or signify his approval.

3. Contractor shall be responsible for the correctness of all drawings furnished by him, although the drawings may be approved by the Purchaser.

4. Any work done by the Contractor prior to the approval of the Contractor's drawings will be done at the Contractor's risk, unless previously authorized in writing by accredited representative of the Purchaser.

5. No change shall be made in any approved drawing without the written consent of the Purchaser.

6. After completion of the contract, the Contractor shall designate on station map the location of underground cables and such other information as may be required by the Purchaser and shall furnish corrected tracings of drawings furnished by him in accordance with section 3-e.

(d) Contractor shall furnish with his tender, drawings forming an essential part thereof.

(e) After award of the contract and before work is begun, the Contractor shall furnish for the approval of the Purchaser the following drawings as scheduled by the Purchaser:

1.
2.

4. *Furnished by the Purchaser.*

(a) Purchaser will obtain necessary permits from Federal, State and Municipal authorities.

4. *Furnished by the Purchaser.*—Continued.

(b) Purchaser will furnish, as indicated in sections 4-c, d and e, material or labor, or both, on the following items:

1. Ties for support of apparatus.
2. Move ties as may be necessary.
3. Move switch and tie rods as may be necessary.
4. Insulated rail joints.
5. Bridge insulations.
6. Switch-rod insulations.
7. Tie-rod insulations.
8. Gage-plate insulations.
9. Concrete material:
 - (a) Cement.
 - (b) Sand.
 - (c) Stone.
 - (d) Water.
10. Precast foundations.
11. Necessary grading and drainage.
12. Excavation of solid rock.
13. Poles for line wire.
14. Cross-arms, pins, insulators and fittings.
15. Line wire.
16. Housings:
 - (a) Instrument.
 - (b) Battery.
17. Cables:
 - (a) Aerial.
 - (b) Submarine.
 - (c) Underground.
 - (d)
18. Conduits:
 - (a) Main.
 - (b) Branch.
 - (c)
19. Manholes.
20. Track bonding.
21. Sand, clay or loam for cable trench, including protection plank.
22. Apply necessary attachments to signal apparatus in service.
23. Make necessary alterations of any part of existing structures or apparatus.
24. Make necessary alterations to existing circuits.
25. Unload and properly house material that arrives on the ground before the Contractor's force; this work to be done under the supervision of the Contractor's representative.
26. Distribute material.
27. Buildings.
28. Tools, fixtures for building and supplies required for the maintenance of the system.

4. *Furnished by the Purchaser.*—Continued.

29. Communication system.

30. Control panel for manual supervision.

31. Paint.

32.

33.

(c) Material only on items

(d) Labor only on items

(e) Material and labor on items

(f) Purchaser will furnish the items as indicated in sections 4-c, d and e, subject to inspection of the Contractor, who shall state any objections thereto before starting his part of the work. After rectification by the Purchaser of any defects reported, the Contractor shall assume full responsibility for the proper functioning of the installation. The intent of this section is to bar any claim by the Contractor that the work done by the Purchaser has not been performed in such manner as to enable him to fulfill all the provisions of the contract.

5. *Alternates.*

(a) The provisions contained in the alternate requisites section of this specification form a part hereof only when substituted by Purchaser's order for the provisions contained in this specification.

(b) Where blanks have not been filled, or where an option is permitted and no preference stated, the Contractor's recommended practice shall be followed.

6. *Shipment of material.*

(a) Material shall be shipped to, care of, marked for
Material shipped from Contractor's factory at
shall be shipped via and thence via
..... to destination.

7. *Transportation.*

(a) Purchaser will furnish transportation for men, necessary for the installation, over the following lines (*R-7-a):

1.

2.

(b) Purchaser will furnish transportation for tools and material, necessary for the installation, over the following lines (*R-7-b):

1.

2.

* Alternate requisites section.

8. *Inspection of installation.*

(a) Contractor shall advise the Purchaser days in advance of the time installation will be completed and ready for final inspection. Purchaser will make inspection and tests within days after completion of the work.

9. *Tests.*

(a) Contractor shall make such tests as may be necessary to demonstrate, to the satisfaction of the Purchaser, that the apparatus, as installed, is in accordance with the requirements of the specifications and contract. These tests, unless otherwise specified, shall include the tests shown in section 9-b and shall be conducted in accordance with A.A.R. Signal Section instructions for testing, where applicable, otherwise as directed by the Purchaser. Contractor shall provide such instruments and apparatus as may be necessary for making tests. Instruments and apparatus shall remain the property of the Contractor.

(b) The following tests shall be made:

1. General.

(a) Service test to determine that protective devices function as intended.

(b) Service test to determine that control system functions as intended.

(c) Test to determine that all circuits conform to approved circuit plans by individually electrically checking each contact selection.

(d) Test of all electrically operated devices to determine that electrical operating characteristics are in accordance with specifications designated by the Purchaser.

2. Insulation.

(a) Test of insulation resistance of each complete circuit, in accordance with Purchaser's instructions, shall be made when wires, cables and insulation involved are dry.

(b) Switch-rod insulation shall be tested in accordance with Specification 216, Manual Part 116.

3. Switch circuit controllers.

(a) Test to determine that switch circuit controllers are in accordance with Instructions for Switch Circuit Controllers, Manual Part 134.

4. Track circuits.

(a) Test to determine that track circuits have been installed in accordance with approved plans and adjusted in accordance with Instructions for Track Circuits, Manual Parts 8, 162 and 218.

9. *Tests.*—Continued.

5. Voltage.

(a) Test to determine that voltage for all apparatus is in accordance with Manufacturer's specifications and that voltage applied to lamps is in accordance with specifications furnished by the Purchaser.

10. *Placing in service.*

(a) After receipt of written authority from the Purchaser, the Contractor shall place the installation in service under supervision of the Purchaser, and shall leave competent men on duty for days thereafter. *R-10-a.

11. *Completion.*

(a) When installation is completed, apparatus and surface of the ground which has been affected by the installation, shall be left in a neat and clean condition.

12. *Clearances.*

(a) Clearances shall conform to clearance diagram furnished by the Purchaser.

*Detail Provisions*13. *Transformers.*

(a) Oil-cooled transformers shall be in accordance with Specification 84, Manual Part 165.

(b) Air-cooled transformers shall be in accordance with Specification 83, Manual Part 164.

(c)

14. *Rectifiers.*

(a) Rectifiers shall be of type.

(b) Rectifiers shall be in accordance with the following specifications, where applicable:

1. Copper-Oxide Rectifiers and Valves—Specification 166, Manual Part 139.

2. Tantalum Rectifiers and Valves—Specification 189, Manual Part 47.

3. Selenium Rectifier—Specification 229, Manual Part 243.

4. Rectifier—Specification, dated

(c) Track circuit rectifier characteristics.

1. A.C. volts, cycles

* Alternate requisites section.

14. *Rectifiers.*—Continued.

2. D.C. volts max., min., amperes max., min., for:
 - (a) Operating track circuits direct.
 - (b) Charging cells, type storage battery.
 - (c) Use in multiple with cells, ampere-hour type primary battery.
- (d) Line circuit rectifier characteristics.
 1. A.C. volts , cycles
 2. D.C. volts max., min., amperes max., min., for:
 - (a) Operating line circuits direct.
 - (b) Charging cells, type storage battery.
 - (c) Use in multiple with cells, ampere-hour type primary battery.
- (e) Signal operating rectifier characteristics.
 1. A.C. volts , cycles
 2. D.C. volts max., min., amperes max., min., for:
 - (a) Operating signals direct.
 - (b) Charging cells, type storage battery.
 - (c) Use in multiple with cells, ampere-hour type primary battery.
- (f) rectifier characteristics.
 1. A.C. volts , cycles
 2. D.C. volts max., min., amperes max., min., for:
 - (a)
 - (b) Charging cells, type storage battery.
 - (c) Use in multiple with cells, ampere-hour type primary battery.

15. *Foundations.*

- (a) The Purchaser will, in the presence of the Contractor's representatives, designate the location of each foundation.
- (b) Foundations shall be rigid and level.
- (c) Elevation and distance of foundations from track shall be in accordance with Purchaser's requirements.
- (d) Foundations for ground mast signals and instrument cases shall conform to Drawings 1107, 1259, 1687, 1694 and 1695. *R-15-d.
- (e) Foundations not otherwise specified shall be in accordance with Purchaser's requirements.

* Alternate requisites section.

15. *Foundations.*—Continued.

(f) Concrete foundations shall be allowed to properly set before any apparatus is connected thereto or placed thereon.

(g) Foundations shall be so constructed that apparatus can be removed without disturbing foundation.

(h) Dimensions of foundations shall be applicable to level and solid ground. The Purchaser and Contractor shall jointly decide when deviations from specified sizes are necessary.

(i) Foundations shall be provided by _____, in accordance with Specification _____, dated _____, and Drawing _____, dated _____.

16. *Concrete.*

(a) Concrete shall be in accordance with Purchaser's Specification _____, dated _____.

17. *Signals.*

(a) Signals shall conform to Drawing 1462, 1488, 1489, 1651, 1652, 1653, 1654, 1686 or 1688.

(b) Electric light unit for highway crossing signal shall be in accordance with Specification 190, Manual Part 166, or Specification 232, Manual Part 244.

(c) Electric motor mechanism and gate arms shall be in accordance with Specification 199, Manual Part 194.

(d) Crossing signals shall be in accordance with Requisites for Highway Grade Crossing Signals, Manual Part 148.

(e) Automatic gates shall be in accordance with Requisites for Automatic Gates, Manual Part 35.

(f) "No Right Turn" and "No Left Turn" signals shall be in accordance with Requisites for "No Right Turn" and "No Left Turn" Signals, Manual Part 224.

(g) Bells shall be in accordance with Specification 44, Manual Part 21.

18. *Controls.*

(a) Controls shall be in accordance with Requisites for Control of Automatic Highway Grade Crossing Signals and Devices, Manual Part 274.

19. *Wires and cables.*

(a) Wires and cables shall be in accordance with the following specifications:

1. Copper-Bearing Steel Line Wire—Specification 196, Manual Part 181.

2. Copper-Covered Steel Line Wire—Specification 167, Manual Part 180.

3. Copper Alloy Line Wire—Specification 168, Manual Part 173.

4. Copper Line Wire—Specification 169, Manual Part 182.

19. *Wires and cables.*—Continued.

5. Specification for Galvanized Steel Strand, Manual Part 184.
6. Specification for Bronze Guy and Messenger Strand, Manual Part 70.
7. Copper-Covered Steel Guy and Messenger Strand—Specification 173, Manual Part 69.
8. Insulated Wire, A.V.C.—Specification 192, Manual Part 187.
9. Insulated Wire—Specification 111, Manual Part 186.
10. Aluminum Cable Steel Reinforced Line Wire—Specification 54, Manual Part 24.
11. Braid-Covered Cable—Specification 89, Manual Part 25.
12. Lead Sheathed Cable, Submarine—Specification 90, Manual Part 26.
13. Lead Sheathed Cable, Non-Armored—Specification 91, Manual Part 28.
14. Lead Sheathed Cable, Armored—Specification 145, Manual Part 20.
15. Polychloroprene Sheathed Cable with Outer Covering—Specification 161, Manual Part 36.
16. Polychloroprene Sheathed Cable—Specification 240, Manual Part 249.
17.
18.

20. *Size of wire.*

- (a) Wire shall be of sufficient size to permit operation of signals in accordance with this specification.
- (b) Single-conductor wires outside buildings and instrument cases shall be not smaller than No. A.W.G.
- (c) Wires and cables shall be not smaller than No. A.W.G.
- (d) Line wires shall be not smaller than No. A.W.G. for hard-drawn copper or No. A.W.G. for copper-covered steel.
- (e) Common wire shall have conductivity of not less than that of No. A.W.G. hard-drawn copper.
- (f) Spare wires shall be provided as follows:
 1.
 2.
- (g) Track circuit wires shall be as follows:

	No. of conductors	A.W.G.	Wire or cable
1. Energy to rail.....			
2. Relay to rail.....			
3. Fouling shunt connections.....			

20. *Size of wire.*—Continued.

(h) Control wires shall be not smaller than No.
A.W.G.

21. *Wiring.*

(a) Wiring shall be in accordance with Specification 119, Manual Part 84.

(b) Lead cable underground without any other mechanical protection shall be placed in conduit.

(c) Wiring shall be handled in accordance with Instructions for Wire and Cable, Manual Part 190.

(d) Rubber-insulating tape and friction tape shall be in accordance with Specification 56, Manual Part 158 and Specification 88, Manual Part 157, respectively. *R-21-d.

(e) All wires shall be marked with tags in accordance with Purchaser's prescribed practice.

22. *Terminal blocks.*

(a) Terminal blocks shall conform to Drawing 1054, 1056 or 1077. *R-22-a.

23. *Fuses.*

(a) Fuses shall be:

	Type	Voltage	Capacity
1.			
2.			

(b) Fuse clips shall be mounted on insulating base of fireproof material.

(c) Necessary fuses to properly protect all apparatus and circuits as required by the Purchaser shall be installed by the Contractor. *R-23-c.

24. *Bonding.*

(a) Bonds shall be type and bonding installed in accordance with Specification 135, Manual Part 22. *R-24-a.

(b) Impedance bonds shall be in accordance with Specification 74, Manual Part 67.

25. *Power.*

(a) Two sources of power shall be provided for the operation of each crossing signal. Where commercial power is not available this provision may be accomplished by the use of two batteries with multiple connections between the two batteries.

26. *Batteries.*

(a) Batteries shall be in accordance with the following specifications and drawings:

* Alternate requisites section.

26. Batteries.—Continued.

1. Nickel, Iron, Alkaline Storage Battery—Specification 49, Manual Part 15.

2. Lead Acid Stationary Storage Battery (Plates of Pure Lead)—Specification 58, Manual Part 19.

3. Lead Type Portable Storage Battery for Signaling—Specification, dated

4. Lead Acid Stationary Storage Battery (Plates of Alloy Composition)—Specification 158, Manual Part 117.

5. Lead Acid Stationary Storage Battery (Plates of Composite Structure)—Specification 53, Manual Part 18.

6. Specification for Electrolyte, Manual Part 13.

7. Type "A" Copper-Oxide Caustic Soda Primary Cell—Specification 87, Manual Part 6.

8. Battery Jar (Primary)—Specification 113, Manual Part 9.

9. Battery Jar (Storage)—Specification, dated

10. Round Jars and Cover—Drawing 1053.

11. Rectangular Jars and Cover—Drawing 1419.

(b) Jars for caustic soda type of battery shall conform to Drawing, dated

(c) Track batteries shall be type and ampere-hour capacity.

(d) Line batteries shall be type and ampere-hour capacity.

(e) Operating batteries shall be type and ampere-hour capacity.

27. Relays.

(a) Direct current relays.

1. Tractive armature direct current neutral relays shall be in accordance with one or more of the following specifications:

(a) Two or More Contact Fingers—Specification 105, Manual Part 123.

(b) Series Line Approach Lighting—Specification 154, Manual Part 101.

(c) Interlocking Relay—Specification 186, Manual Part 105.

(d) Plug-in Type—Specification 204, Manual Part 77.

(e) Biased Neutral Relay—Specification 228, Manual Part 232.

(f) For Non-Vital Circuits—Specification 224, Manual Part 228.

(g) Detachable Type for Non-Vital Circuits—Specification 180, Manual Part 145.

27. *Relays.*—Continued.

(h) Track relays shall be of ohms resistance and have not more than nor less than contact fingers.

(i) Line relays shall be of ohms resistance and have not more than nor less than contact fingers.

2. Flasher relay shall be in accordance with Specification 185, Manual Part 143.

3. Time element relay shall be in accordance with Specification 197, Manual Part 1, or Specification 202, Manual Part 2.

4. Other types of direct current relays shall be as follows:

- (a)
- (b)

(b) Alternating current relays.

1. Relays shall be of the following type:

- (a)
- (b)

2. Alternating current relays shall be in accordance with Specifications 78 and 148, Manual Parts 122 and 53.

3. Track relays shall operate on and have contact fingers:

(a) Single-element volts cycles and not more than nor less than contact fingers.

(b) Two-element relays shall have not more than nor less than contact fingers and shall have windings for operation on:

- 1. Track winding volts cycles.
- 2. Local winding volts cycles.

4. Line relays shall operate on and have contact fingers.

(a) Single-element volts cycles and not more than nor less than contact fingers.

(b) Two-element relays shall have not more than nor less than contact fingers and shall have windings for operation on:

- 1. Line winding volts cycles.
- 2. Local winding volts cycles.

5. Power transfer relays shall be in accordance with Specification 148, Manual Part 53.

6. Other types of alternating current relays shall be as follows:

- (a)
- (b)

28. *Reactors and resistors.*

(a) Reactors shall be in accordance with Specification 104, Manual Part 121.

28. *Reactors and resistors.*—Continued.

(b) Resistors shall be in accordance with Specification 106, Manual Part 135.

29. *Lightning arresters.*

(a) Line arresters, type, shall meet A.I.E.E. requirements and shall be installed as shown on circuit drawings.

(b) Low-voltage arresters, type, shall meet the requirements of Specification 52, Manual Part 95, and shall be installed as shown on circuit drawings.

(c) Arrester grounds shall be in accordance with Specification 60, Manual Part 92. Contractor's liability is limited to grounding elements per ground.

30. *Bootlegs.*

(a) Bootlegs shall conform to Drawing, dated

31. *Track circuit connectors.*

(a) Track circuit connectors shall conform to Drawing 1047, 1048, 1631 or 1632. *R-31-a.

32. *Line construction.*

(a) Line construction shall be in accordance with Purchaser's prescribed practice.

33. *Conduits.*

(a) Conduits shall be in accordance with the following:

1. Specification for Fibre Conduit, Manual Part 37.
2. Specification for Communication Underground Conduit Construction, Manual Part 38.
3. Specification for Steel Pipe Conduit, Manual Part 39.
4. Specification for Wrought Iron Pipe Conduit, Manual Part 40.
5. Specification for Vitrified Clay Conduit, Manual Part 41.

34. *Instrument and battery housings.*

(a) Instrument housings shall conform to the following drawings:

1. Cable Post—Drawing 1192.
2. Relay Box Inlet Bracket—Drawing, dated
3. Relay Box Linings and Terminal Boards—Drawing, dated
4. Relay Box Fittings—Drawing, dated

* Alternate requisites section.

34. *Instrument and battery housings.*—Continued.

5. Relay Box and Cable Post Mountings—Drawing, dated

6. Steel Instrument House—Drawing, dated

7. Steel Instrument Case—Drawing 1601, 1626, 1627 or 1628.

8. Concrete housing shall conform to Drawing, dated

9. Relay racks shall conform to Drawing, dated

10.

(b) *Battery housings.*

1. Battery housings shall conform to Drawing, dated

2. Concrete battery boxes shall conform to Drawings 1266, 1267, 1268 and 1269.

3. Battery racks shall conform to Drawing, dated

35. *Insulated rail joints.*

(a) Insulated joints shall be type and for section, lbs. rail with hole drilling.

(b) Insulated joints shall be installed in accordance with Instructions for Insulated Rail Joints, Manual Part 133.

(c) Insulated joints shall be located as shown on Drawings 1634, 1635, 1636, 1637 and 1638.

36. *Painting.*

(a) Painting shall be in accordance with Specification 120, Manual Part 110, and the following:

1. Requisites for Highway Grade Crossing Signals and Devices, Manual Part 274.

2. Requisites for "No Right Turn" and "No Left Turn" Signals, Manual Part 224.

37. *Padlocks.*

(a) Purchaser's padlocks shall be furnished by and shall be used where specified.

38. *Circuit controllers.*

(a) Universal switch circuit controllers shall be in accordance with Specification 95, Manual Part 49. *R-38-a.

(b) Switch circuit controller connections shall conform to Drawings 1255, 1256, 1271 and 1272. *R-38-b.

(c) Switch circuit controllers shall be connected to the normally closed switch point.

* Alternate requisites section.

38. *Circuit controllers.*—Continued.

(d) circuit controllers shall be in accordance with

39. *Control panel.*

(a) Control panel for manual supervision design, shall be installed as shown on Drawing, dated

40. *Communication system.*

(a) Telephone systems shall be in accordance with A.A.R. Communications Section Specification.

(b) system shall be installed as specified by Purchaser.

41. *Fibre insulation.*

(a) Fibre insulation shall be in accordance with Specification 13, Manual Part 58.

42. *Electric lamps.*

(a) Incandescent electric lamps shall be in accordance with Specification 51, Manual Part 91, and conform to Drawings 1541, 1542 and 1543.

43. *Special items.*

(a)

Alternate requisites.

R-7-a.

Contractor will furnish transportation for men, necessary for the installation, over the following lines:

1.
2.

R-7-b.

Contractor will furnish transportation for tools and material, necessary for the installation, over the following lines:

1.
2.

R-10-a.

Purchaser will place the installation in service in the event that he does not authorize the Contractor to do so within days after completion of the work, to the Purchaser's satisfaction.

R-15-d.

Foundations for ground mast signals and instrument cases shall conform to Drawing, dated

Alternate requisites.—Continued.

- R-21-d. Insulating tape shall be in accordance with Purchaser's requirements.
- R-22-a. Terminal blocks shall be
- R-23-c. Fuses shall be installed as follows:
- R-24-a. Bonding shall be installed in accordance with Specification
....., dated
- R-31-a. Track circuit connectors shall conform to Drawing,
dated
- R-38-a. Switch circuit controllers shall be
- R-38-b. Switch circuit controller connections shall conform to

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter
in the Manual.

Subject-matter to be Superseded

Specification 176-41—Highway Grade Crossing Signals, Manual Part 149
and Specification 209-50—Highway Grade Crossing Automatic Gates,
Manual Part 179.

METHODS FOR PREVENTING UNNECESSARY OPERATION OF AUTOMATIC HIGHWAY GRADE CROSSING PROTECTIVE DEVICES

A.A.R. Signal Section Requisites for Control of Automatic Highway Grade Crossing Signals and Devices, Manual Part 274, read in Requisite 4-d as follows:

"Where train speeds on a given track vary considerably, a single operating circuit of such length as to provide adequate warning of the approach of trains at the higher speed may produce too long a warning time for slower trains. In such cases, additional operating circuits may be provided with timing devices so arranged that a warning time, not too long for the slower trains, will be automatically selected."

In order to obtain a preliminary summary of present practices in effect on various railroads and further to obtain information on means that are provided for avoiding the unnecessary operation of the crossing protective devices during intervals when trains make regular operating stops or perform switching operations on the approach circuits, a questionnaire was submitted to members of Committee VIII for a report regarding the practices on their railroads.

The replies indicate that local conditions appear on each railroad, requiring consideration of arrangements to avoid considerable differences in protective device operating time between high and low train speeds and where unnecessary operation of the devices may result by train making regular operating stop or performing switching operation on approach circuits. Consideration for eliminating these causes for unnecessary operation of protective devices is indicated wherever required by State regulations, railroad traffic conditions or highway traffic conditions.

The replies made by 14 members of Committee VIII, covering the conditions and practices on 12 railroad systems which operate in areas that generally reflect the entire United States, reveal many local conditions which require special circuits and which also require in many instances special operating rules or instructions.

The questions submitted with a summary of the answers, follow:

1. Slow train approaching on main track where trains are also operated at high speed.

All 14 replies indicated the use of selective speed controls where required by State regulations, railroad traffic conditions or highway traffic conditions. Nine of the replies made no qualifications as to the application; five qualified their information as applying to gate installations only.

2. Train making station stop or stopping to take coal or water, in approach control circuits.

Of the 14 replies received 13 indicated use of a cut-out and one the use of a cut-out where selective speed controls were not used. Thirteen indicated automatic time cut-out and one manual cut-out. Eight replies mentioned the use of positive restart with the automatic time cut-out; one indicated use of track instrument for restart in special cases; one indicated manual automatic restoration.

3. Train leaving siding and moving away from crossing in approach control circuit.

Thirteen replies were received, of which 11 indicated reverse switch cut-out and 2 automatic time cut-out.

4. Train performing switching within the limits of the approach control circuits.

All replied to this question, 10 indicating automatic time cut-out; 1 manual cut-out; 3 automatic time or reverse switch cut-out. Six indicated positive restart; 1 manual restart; 1 track instrument restart; 2 special circuits with operating instructions.

5. Train stopped by a controlled signal within limits of the approach circuit.

All replied that circuits are provided to prevent operation of crossing protection when signal indicates Stop.

6. Train leaving cars in approach control circuit. Indicate minimum permissible length of positive restart section.

Nine replies were received to this question. In general, the replies indicate that positive restart sections vary up to a maximum of 600 feet. In the absence of positive restart sections or where extreme short sections are used, operating instructions are necessary.

In addition to the digest of the answers to the questionnaire as reported in the foregoing, a special review was made of methods that are being used to engineer highway grade crossing device installations so as to meet the full requirements of each installation as related to highway traffic problems, local government problems and railroad operating problems. It was clearly revealed that careful preliminary studies should be made on the ground by railroad operating and signal representatives along with State Highway and Public Commission personnel, before final plans are made.

One railroad involved in this study has made a concerted effort to follow this practice and reports very successful cooperation with resultant satisfaction in the operation of its devices both from the railroad standpoint and public use standpoint. A brief outline of the procedures followed by this railroad for a typical location and results obtained, follows:

Automatic flashers and gates with sidewalk arms were requested by county authorities for a crossing located within interlocking limits intersecting three main tracks at right angles, the approaches of which would include three suburban passenger depots. In addition, the crossing is so located with respect to the receiving and departing yards, which are located on opposite sides of the main tracks, that all movements of inbound and outbound freight trains as well as movements from one yard to the other are made over this crossing.

Vehicular and pedestrian traffic over this crossing in a 24-hour period consists of 386 pedestrians, 756 trucks, 4,507 automobiles, 128 buses and 22 bicycles, totaling, 5,801.

Railroad traffic at this crossing consists of 97 passenger trains, 41 freight trains and 72 switching movements, totaling 210 gate operations in a 24-hour period. Maximum speed over this crossing is 75 miles per hour.

After a thorough check on the ground with all interested parties, at which time it was determined that automatic protection would be practical, the matter was presented to the city authorities for their concurrence in replacing the manual protection with automatic protection. At the beginning, the city objected to the proposed change due mainly to the fact that they were unaware that such automatic protection could be made to operate with a minimum of delay to highway traffic. After a detailed explanation of the proposed protection, the city withdrew its objection and with the concurrence of the Public Commission, the automatic flashers and gates were installed and placed in service February 1949.

In the design of the control circuits for this installation, a careful analysis of all known devices and circuits was made in order to provide the maximum in safety and efficiency. Selective speed controls, bypasses with control signal in Stop position and route selections along with directional stick, interlocking and quick-acting track relays were used in this installation. Periodic operational checks of the installation show the approach operating time varying between 20 and 43 seconds for all movements over this crossing. Since these automatic flashers and gates have been installed, they have operated without criticism and there have been no accidents at this crossing in so far as the automatic protection is concerned.

Favorable results with this method of handling highway grade crossing protection installations are shown by the fact that this railroad has made a considerable number of complex installations in a like manner which resulted in a marked reduction of crossing accidents and a much improved attitude of the traveling public toward automatic highway grade crossing protection.

Action Recommended

Acceptance as information.

PROGRESS REPORT

USE OF DIFFUSING ROUNDELS IN ELECTRIC LIGHT UNITS FOR
HIGHWAY CROSSING SIGNALS TO PROVIDE A WIDER RANGE
OF INDICATION WHERE A LONG VIEW IS NOT REQUIRED*

Roundels normally used in highway traffic light type signals were obtained and tested by the Committee, to determine their value in railroad flashing light highway signal installations to provide a wider range of indication where a long view is not required. Five roundels normally used in flashing light signals were also obtained for test and comparison purposes.

Manufacturers' curves showing the horizontal and vertical light distribution of clear roundels projected on a parallel plane at 10 feet were obtained. These curves were compared visually with the light output pattern from each of the test roundels listed below by projecting beams on a wall at right angles to the roundel. A 30 degree spreadlight roundel with 15 degree downward deflection was used as a further comparison. Patterns as observed were found to be essentially as shown from the curves.

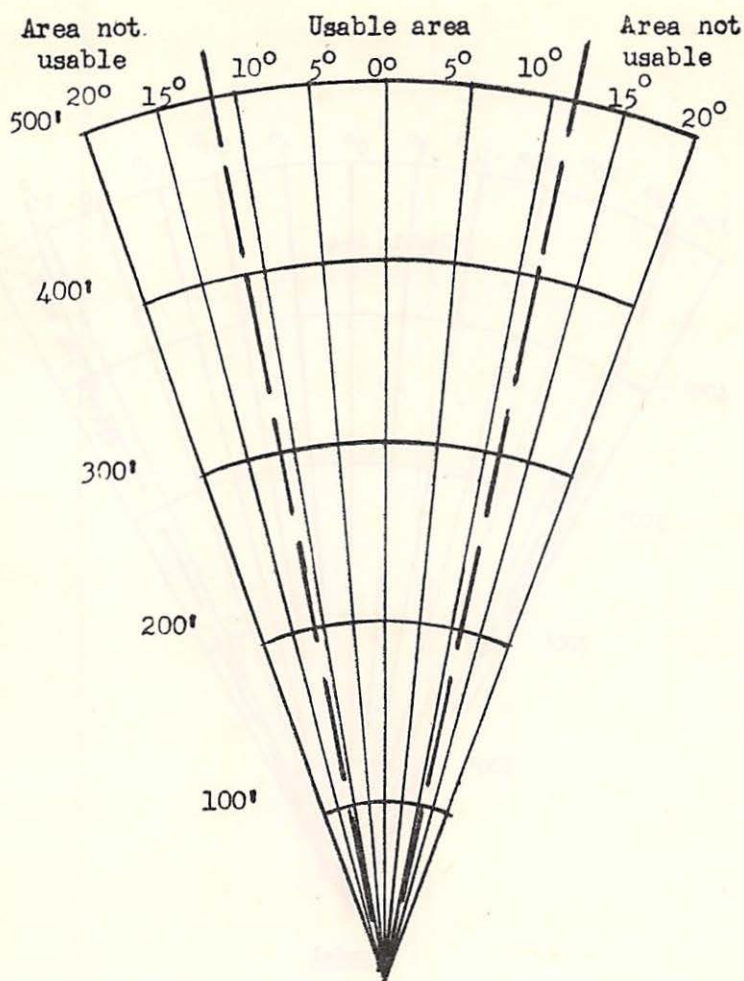
The following roundels were used:

1. 30-degree spreadlight with 15-degree downward deflection.
2. 70-degree horizontal spreadlight without downward deflection.
3. 20-degree horizontal spreadlight with 32-degree downward deflection.
4. Diffusion deflection. Kopp 27. (Curves 4A and 4B.)
5. 30-degree horizontal spreadlight.
6. D Style B-B Traffic Corning 14521.
7. Diffusing Kopp TL 4620.
8. Diffusing Kopp 88 A.
9. Diffusing Kopp 66.
10. Diffusing Corning 553400.
11. Diffusing Corning ME 4969.

A pair of A.A.R. Signal Section Specification 190-50, Manual Part 166, light units was mounted facing in an easterly direction at 7 feet 10 inches above the ground and 2 feet 6 inches apart. Stakes radiating from the units were driven into the ground at stations of a 100-foot interval between zero and 500 feet on a reference line and at 15 and 30 degrees from the reference line. The light units were opened, focused and aligned to give maximum beam intensity at eye level, 200 feet from the mast on the reference line. Ten-volt, 18-watt lamps were used throughout the test, burning at 10 volts.

Daylight observations between the hours of 10:00 a.m. and 3:00 p.m., in sunlight, were made at 100-foot intervals on the reference line and at 5, 10, 15, 20, 25 and 30 degrees from the reference line. The results were plotted graphically and confirmed by observation on the ground. See curves 1 to 11, inclusive.

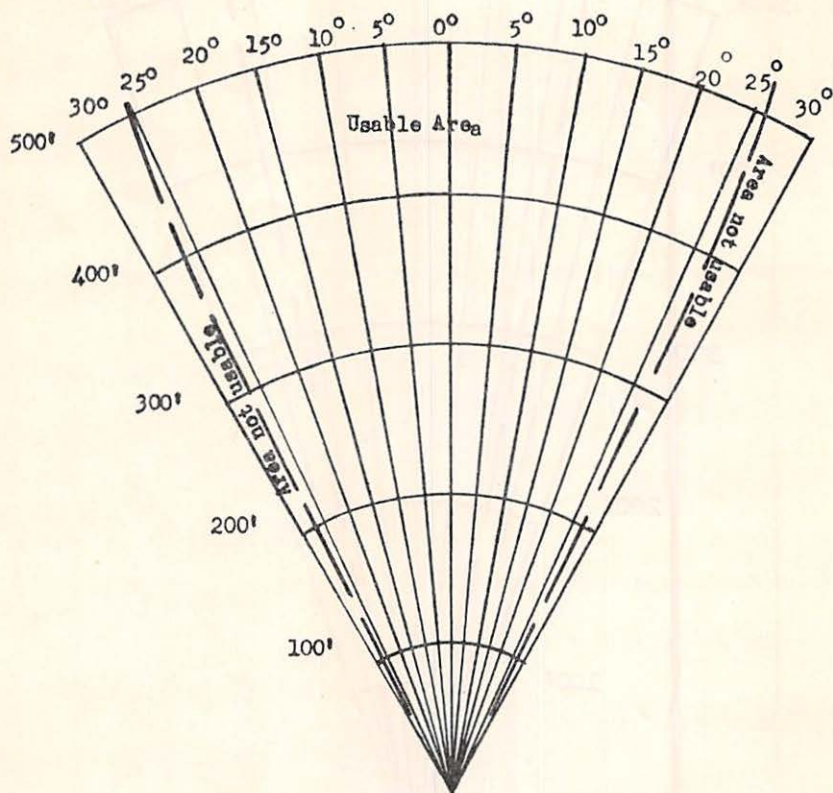
* Previous report on this subject appears in A.A.R. Signal Section 1947 Proceedings, Vol. XLV, pp. 271 and 414.

Roundel

30° spreadlight - 15° downward deflecting
Kopp 4564

Edges of usable area sharply defined

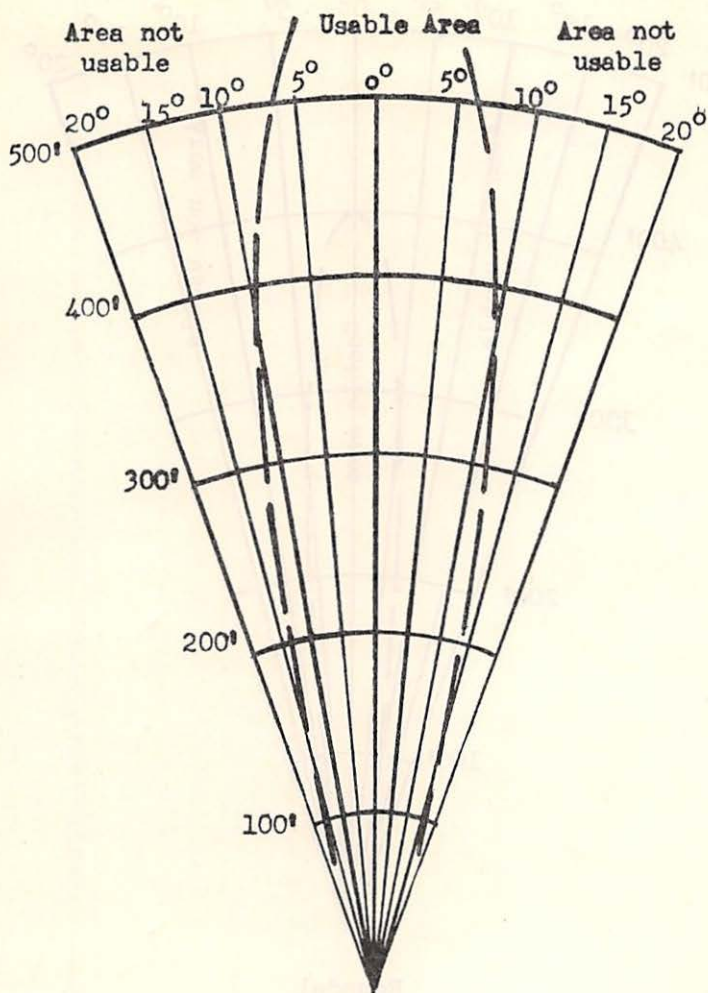
CURVE 1

Roundel

70° horizontal spreadlight

Border line between usable and nonusable area about
5° wide

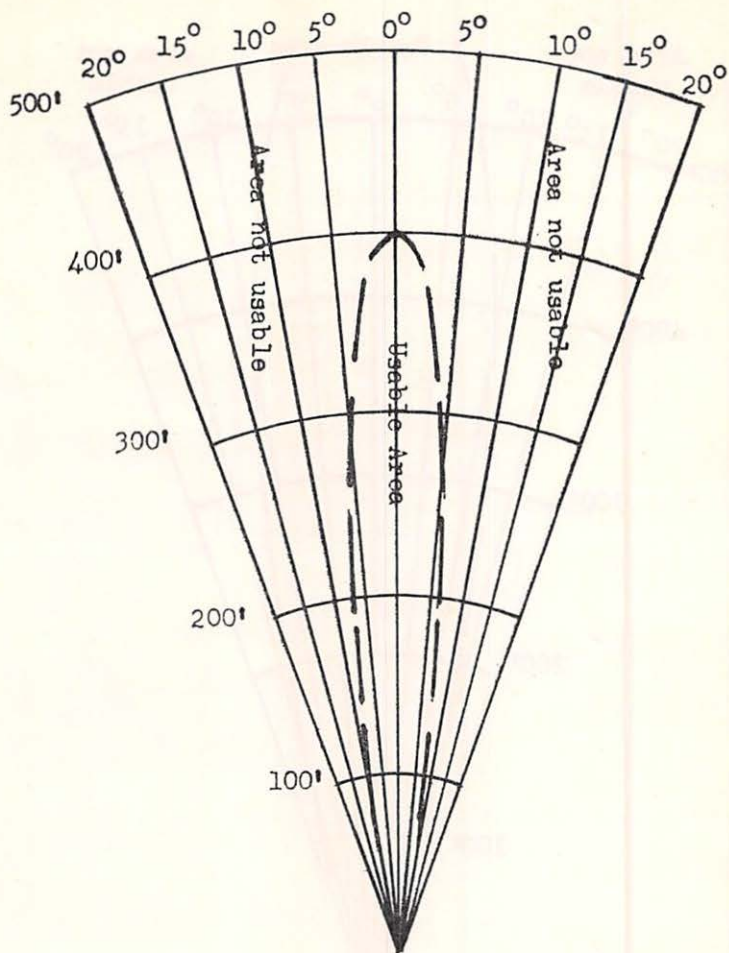
CURVE 2

Roundel

20° horizontal spreadlight with 32° downward deflection
 Corning 55472

Edges of usable area sharply defined

CURVE 3

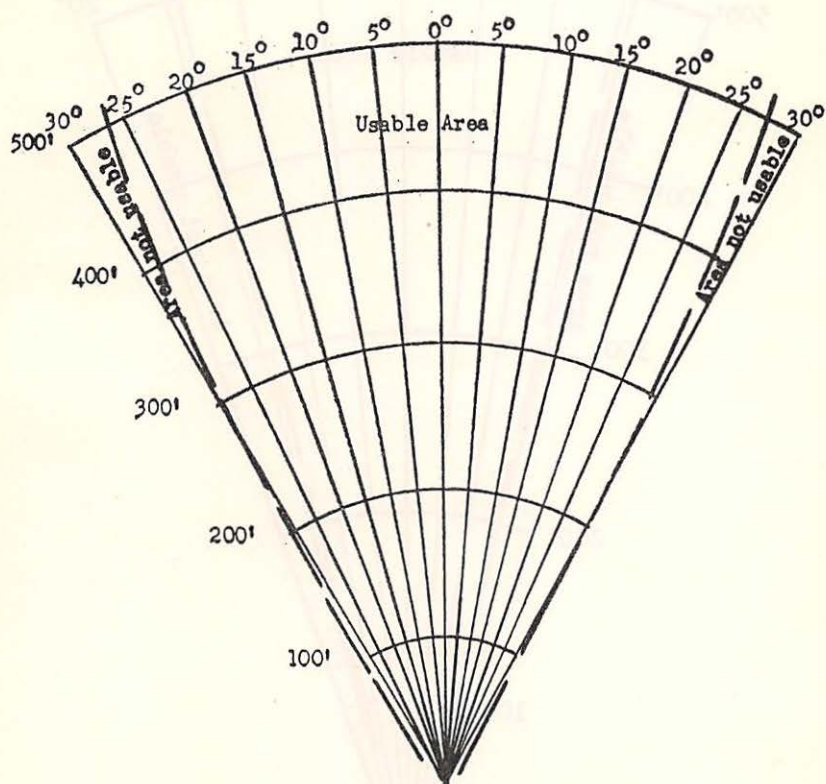


Roundel

Diffusing deflection
Kopp 27

border line between usable and nonusable area about
10° wide

CURVE 4A

Roundel

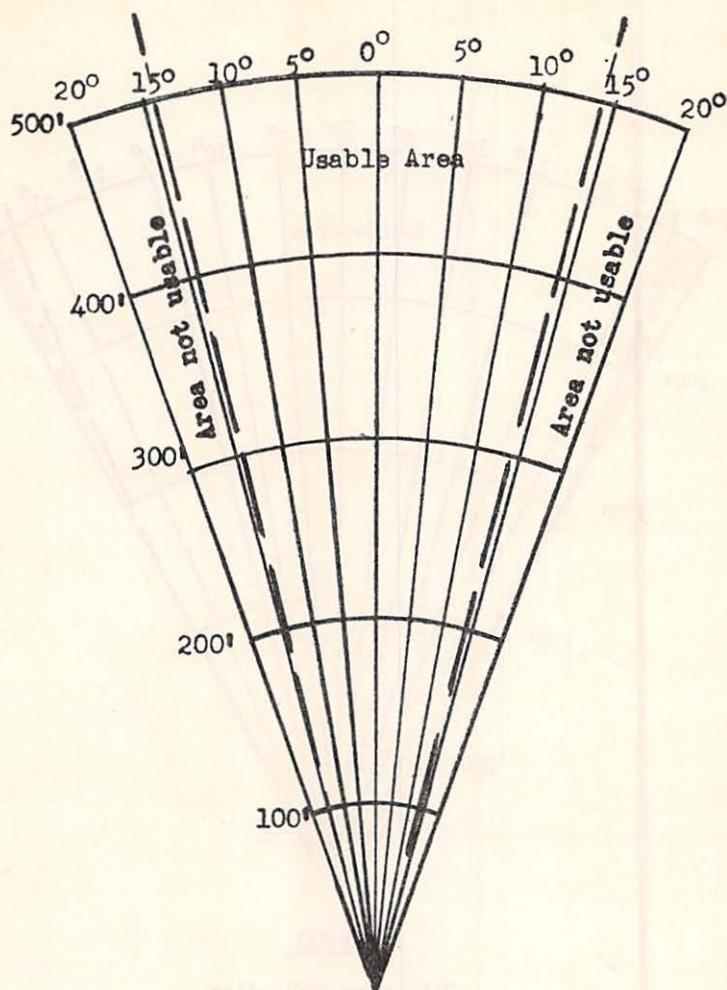
Diffusing deflection

Kopp 27

Lined 5° above horizontal

Border line between usable and nonusable area about
5° wide

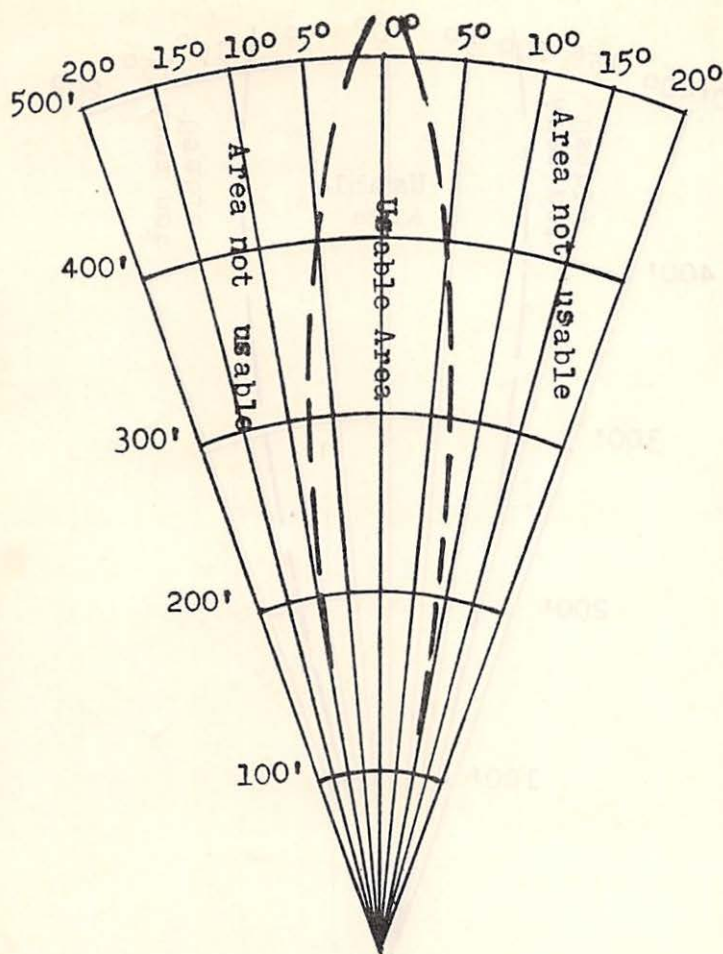
CURVE 4B

Roundel

30° horizontal spreadlight

Edges of usable area sharply defined

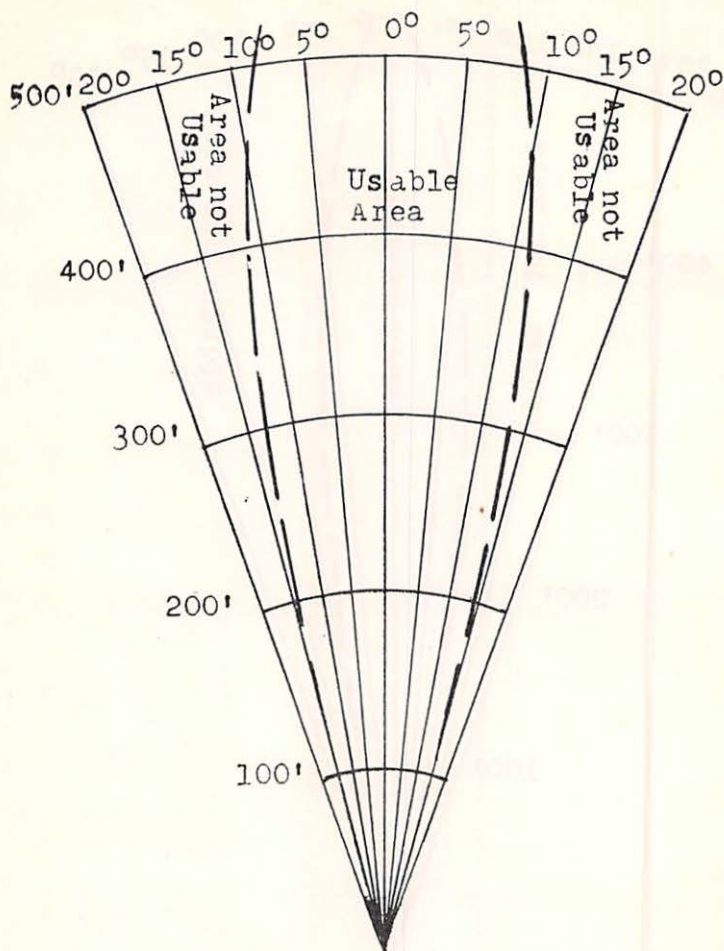
CURVE 5

Roundel

D Style B-B traffic
Corning 14521

Border line between usable and nonusable area about
 5° wide

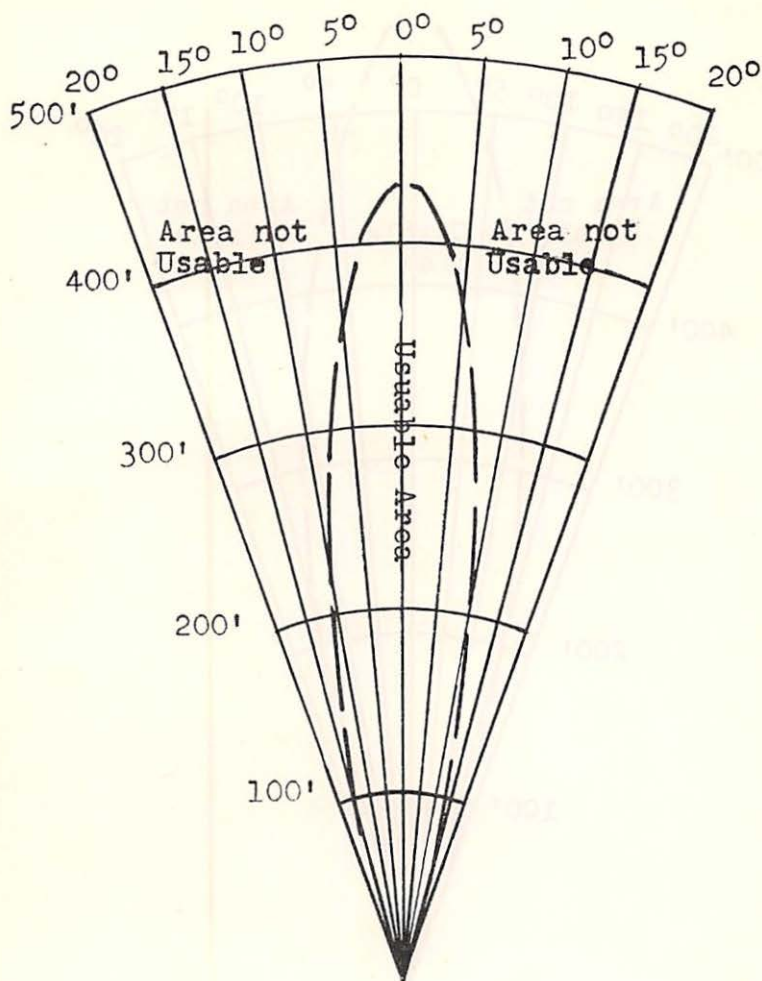
CURVE 6

Roundel

Diffusing
Kopp TL 4620 /

Border line between usable and nonusable area about
10° wide

CURVE 7

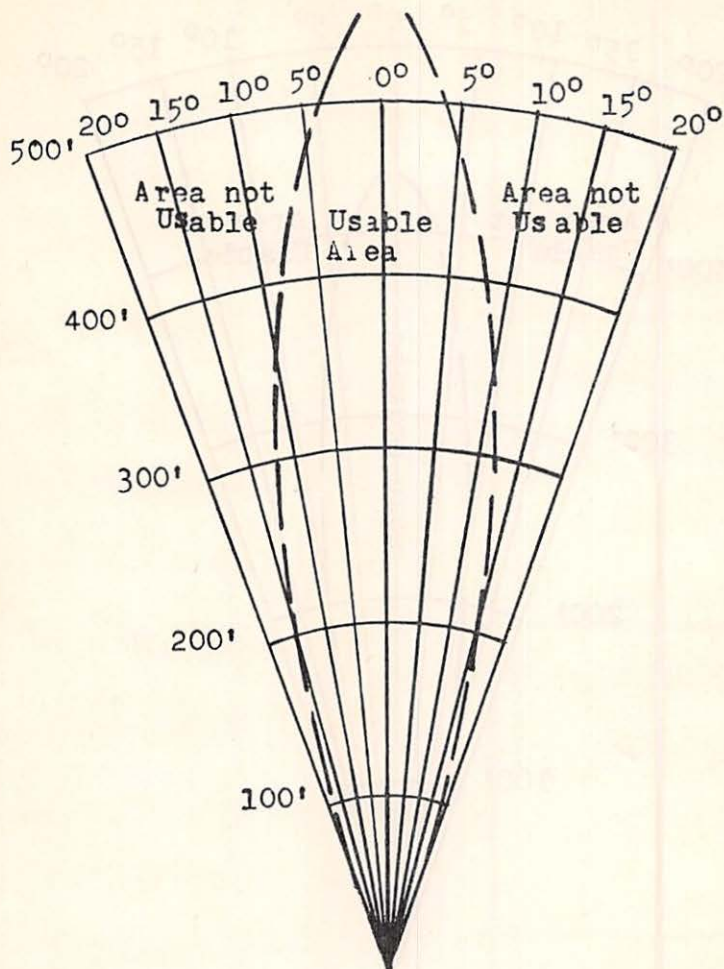


Roundel

Diffusing
Kopp 88A

Border line between usable and nonusable area about
10° wide

CURVE 8

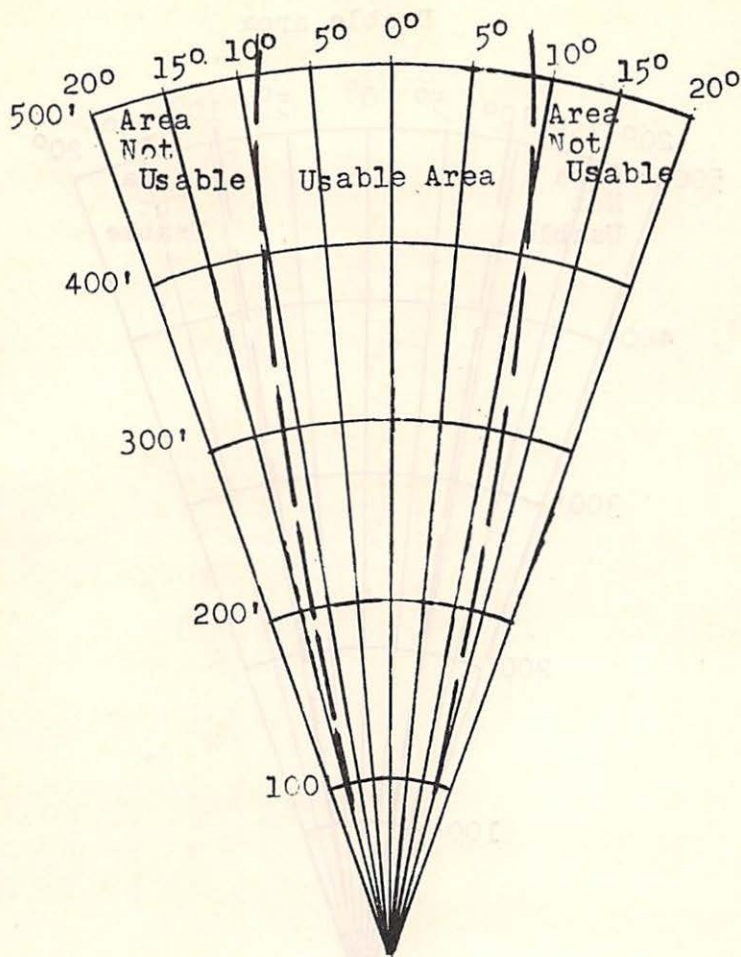


Roundel

Diffusing
Kopp 66

Border line between usable and nonusable area about
10° wide

CURVE 9

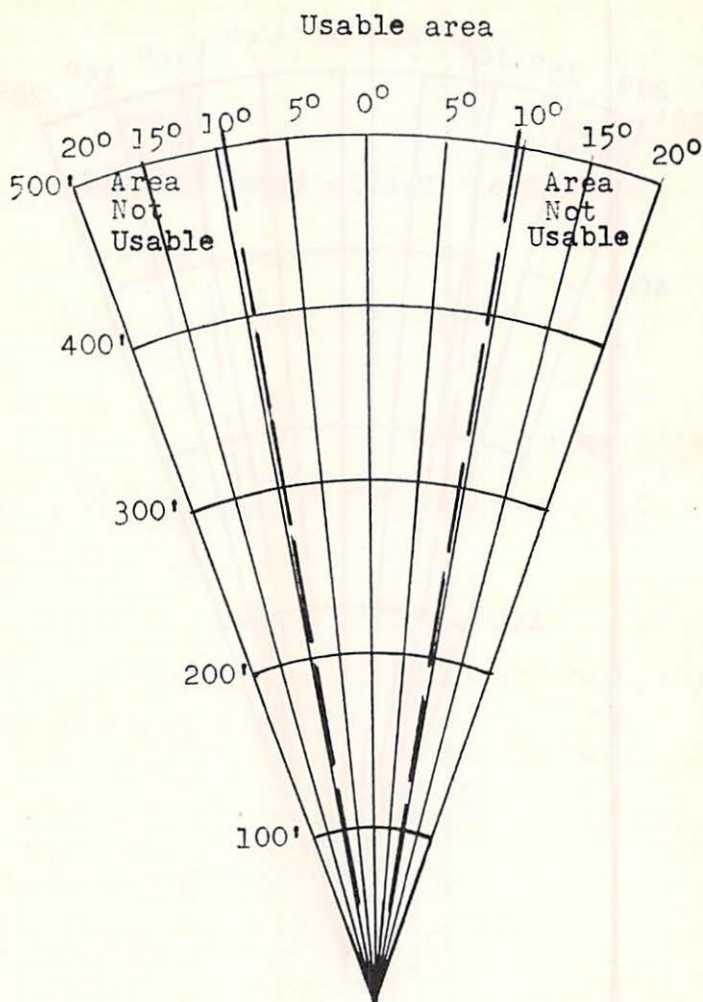
Roundel

Traffic

Corning 553400

Border line between usable and nonusable area about
10° wide

CURVE 10



Roundel

Traffic
Corning ME 4969

Edges of usable area sharply defined

CURVE 11

Data for plotting curves were taken by standing at the axial line of the light units at each of the designated 100-foot stations and then walking back and forth through the angular range of the light units. The angle of spread was determined by ascertaining the point on each side of the base line where the intensity of illumination became materially below normal. This process was repeated for each of the 100-foot station intervals. By this method it is possible to determine points and to construct lines where the intensity of illumination falls off so as to be clearly insufficient.

The area contained within the constructed lines formed by these points, centered about the axis, has been termed the "inner zone" and represents illumination of an intensity deemed to be reasonably sufficient at all points. This does not mean the illumination is uniform at any particular station across this zone but that sufficient illumination is provided in all areas of the zone for warning to highway traffic at railroad grade crossings.

The area outside the inner zone has been termed the "outer zone" and is considered as illumination of too low intensity to meet the needs for warning highway traffic at railroad grade crossings.

All observations were made in comparison with 30-degree spreadlight with 15-degree downward deflecting roundel. In addition, a 30-degree deflecting roundel and a 20-degree roundel with 32-degree downward deflection were observed.

One of the test light units was aligned upward 5 degrees from the original alignment and observations of each of the roundels were made as before. No improvement was observed in any of these except the Kopp 27. The improvement in this roundel is shown by curve 4B. It appears with proper alignment this roundel will give a wide angle of satisfactory close-up indication. Although the curves for the Kopp 27 aligned 5 degrees above horizontal and the 70-degree spreadlight appear the same, it was found that the Kopp 27 gave a more uniform appearance over the inner zone than the 70-degree spreadlight.

Action Recommended

Acceptance as information.

(Revision of Signs Used in Connection With Manually Protected Railroad Highway Grade Crossings, and Advance Warning Signs)

SIGNS USED IN CONNECTION WITH MANUALLY PROTECTED RAILROAD-HIGHWAY GRADE CROSSINGS

1952

The recommended signs used in connection with manually protected railroad-highway grade crossings are as follows:

	Manual— American Railway Engineering Association
Reflector "Watchman Off Duty" Sign.....	Page 9-77
Reflector "Gates Not Working" Sign.....	Page 9-78
Mounting of Reflector Signs.....	Page 9-79
Cover Plates for Signs.....	Page 9-80

These drawings also appear in the current Bulletin on Railroad-Highway Grade Crossing Protection, issued by Train Operation, Control and Signals, A.A.R.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Signs Used in Connection With Manually Protected Railroad Highway Grade Crossings, and Advance Warning Signs, Manual Part 269.

COMMITTEE IX—OVERHEAD AND UNDERGROUND LINES

Personnel

W. W. Beard, Chairman

R. C. Steele, Vice-Chairman

H. H. Cooper

R. H. Smedley

R. W. Margsh

V. O. Smeltzer

M. A. Nyberg

E. P. Stephenson

C. L. Summers

Signal Section, A.A.R.:

The following outline of work has been assigned:

1. Revision of Manual.
2. Indexing signal literature.
3. Investigate and report on wire used in instrument cases and housings, panel and interlocking machines and track model boards.
4. Investigate and report on the difficulties experienced with Signal Section specifications parkway type track wire protective coverings and if found desirable recommend something physically stronger which will better withstand roadway stresses encountered.
5. Investigate and report on extent of failures in Signal Section specifications underground cables attributed to damage caused by rodents, micro-organisms or termites and recommend protection against such damage.
6. Investigate and report on wire used for internal wiring of all types of apparatus.

The Committee submits for consideration, reports on the following subjects*:

1. Revision of Specification 91-50, Manual Part 28.
Revision of Specification 145-50, Manual Part 20.
Revision of Specification, 90-50, Manual Part 26.
Revision of Specification 240-50, Manual Part 249.
Revision of Specification 161-50, Manual Part 36.
Revision of Specification 89-50, Manual Part 25.
Revision of Specification 111-50, Manual Part 186.
Revision of Specification 192-40, Manual Part 187.
Revision of Specification 169-48, Manual Part 182.
Revision of Specification 168-48, Manual Part 173.
Revision of Specification 167-48, Manual Part 180.
Revision of Specification 196-48, Manual Part 181.
Revision of Specification 108-47, Manual Part 175.
Revision of Specification 70-47, Manual Part 176.
Removal of Wire Inspection Report from Manual Part 178.
Revision of Specification 22-46, Manual Part 177.
Revision of Specification 54-39, Manual Part 24.
Removal of Specification for Vitrified Clay Conduit from Manual Part 41.
- Cooperative report. American Society for Testing Materials, Subcommittee IX—Insulating Tapes (Committee D-11—Rubber Insulating Materials).

* Suggestions or criticisms should be submitted in writing to the Chairman of the Committee on or before September 1, 1952.

Information

Specifications, etc., of other organizations referred to in the report of this Committee may be procured from the following:

A.S.A.—American Standards Association, 70 E. 45th St., New York 17, N. Y.
A.S.T.M.—American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.

(Revision of A.A.R. Signal Section Specification 91-50)
A.A.R. SIGNAL SECTION SPECIFICATION 91-52.

LEAD SHEATHED CABLE, NON-ARMORED

Proposed Revision

(This revision is a change in title of the specification only.)

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Title of Specification 91-50—Single and Multiple-Conductor
Insulated Lead Sheathed Cable, Manual Part 28.

(Revision of A.A.R. Signal Section Specification 145-50)
A.A.R. SIGNAL SECTION SPECIFICATION 145-52.

LEAD SHEATHED CABLE, ARMORED

*Proposed Revision*1. *Purpose.*

(a) This specification is for the purpose of providing for single and multiple-conductor, insulated, lead-sheathed signal cable with flat metallic tape armor for installation in direct contact with the earth, in ducts, in the air or in any combination of these types of installation and for use on circuits rated at 0-600 and 601-2500 volts. It sets forth specific detail requirements representing modern signal practice recommended for new installations and for replacement on existing installations when general renewal or replacement becomes desirable.

11. *Armoring.*

(a) The lead sheath shall be armored with flat metallic tapes laid over a jute bedding in accordance with current American Standard C8.15, sections pertaining to "Jute Bedding for Ar-

11. *Armoring*.—Continued.

mored Cables" and "Flat Steel Tape Armor, except jute serving overall," issued by the American Standards Association.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Title and sections 1-a and 11-a of Specification 145-50—Single and Multiple-Conductor, Insulated, Lead-Covered Parkway Cable, Armored With Flat Steel or Zinc Tape, Manual Part 20.

(Revision of A.A.R. Signal Section Specification 90-50)
A.A.R. SIGNAL SECTION SPECIFICATION 90-52.

LEAD SHEATHED CABLE, SUBMARINE

Proposed Revision

(This revision is a change in title of the specification only.)

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Title of Specification 90-50—Multiple-Conductor Insulated Submarine Cable Lead Sheathed and Round Steel Armored, Manual Part 26.

(Revision of A.A.R. Signal Section Specification 240-50)
A.A.R. SIGNAL SECTION SPECIFICATION 240-52.

POLYCHLOROPRENE SHEATHED CABLE

*Proposed Revision*7. *Insulation*.

(a) Conductors shall be individually insulated with a properly vulcanized synthetic rubber-like compound which shall be homogeneous in character, tough, elastic and applied concentrically about the conductor, and shall fit tightly thereto. Where insulation is applied in more than one layer, adjacent layers shall be vulcanized into a homogeneous mass. The insulation shall be in accordance with A.S.T.M. Specification D 27-46T, sections pertaining to "Insulation," except as modified by this specification. Sections 9, 10, 11 and 13 of Specification D 27-46T do

7. *Insulation.*—Continued.

not apply. The insulation shall be in accordance with the following minimum performance requirements (*R-7-a):

1. Physical properties:

Tensile strength, min. psi.....	850
Elongation at rupture, min. per cent.....	300
Set in 2 in. gage length, max. in.....	1/2
Depreciation in tensile strength and elongation after 96 hours in oxygen pressure test, max. per cent.....	35

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Title and section 7-a-1 of Specification 240-50—Single and Multiple-Conductor, Insulated, Polychloroprene Compound Sheathed Cable, Manual Part 249.

(Revision of A.A.R. Signal Section Specification 161-50)
A.A.R. SIGNAL SECTION SPECIFICATION 161-52.

POLYCHLOROPRENE SHEATHED CABLE WITH
OUTER COVERING*Proposed Revision*1. *Purpose.*

(a) This specification is for the purpose of providing for single and multiple-conductor, insulated signal cable with polychloroprene compound sheath for installation in direct contact with the earth, in ducts, in the air or in any combinations of these types of installation and on circuits rated at 0-600 and 601-2500 volts. It sets forth specific detail requirements representing modern signal practice recommended for new installations and for replacement on existing installations when general renewal or replacement becomes desirable.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Title and section 1-a of Specification 161-50—Single and Multiple-Conductor, Insulated, Non-Metallic Sheathed Cable, Manual Part 36.

(Revision of A.A.R. Signal Section Specification 89-50)
A.A.R. SIGNAL SECTION SPECIFICATION 89-52.

BRAID-COVERED CABLE

Proposed Revision

(This revision is a change in title of the specification only.)

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter
in the Manual.

Subject-matter to be Superseded

Title of Specification 89-50—Multiple-Conductor Insulated Cable With
Weather-Resistant or Flame-Retarding Moisture-Resistant Braid
Covering, Manual Part 25.

(Revision of A.A.R. Signal Section Specification 111-50)
A.A.R. SIGNAL SECTION SPECIFICATION 111-52.

INSULATED WIRE

Proposed Revision

1. *Purpose.*

(a) This specification is for the purpose of providing for single-conductor insulated signal wire with braid covering or polychloroprene compound outer sheath for use on circuits rated at 0-600 and 601-2500 volts when wire is not in direct contact with the earth. It sets forth specific detail requirements representing modern signal practice recommended for new installations and for replacement on existing installations when general renewal or replacement becomes desirable.

7. *Insulation.*

(a) Conductor shall be insulated with a properly vulcanized synthetic rubber-like compound which shall be homogeneous in character, tough, elastic and applied concentrically about the conductor, and shall fit tightly thereto. Where insulation is applied in more than one layer, adjacent layers shall be vulcanized into a homogeneous mass. The insulation shall be in accordance with A.S.T.M. Specification D 27-46T, sections pertaining to "Insulation," except as modified by this specification. Sections 9, 10, 11 and 13 of Specification D 27-46T do not apply. The insulation shall be in accordance with the following minimum performance requirements (*R-7-a):

* Alternate requisites section.

Alternate requisites.

R-7-a.

1. Conductor shall be insulated with a properly vulcanized rubber compound known as Class AO, 30 per cent Hevea rubber, and shall be in accordance with the composition, chemical, physical and electrical requirements for Class AO, 30 per cent Hevea rubber compound specified in A.S.T.M. Specification D 27-46T, sections pertaining to "Insulation."

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Title, sections 1-a, 7-a and alternate requisites section R-7-a of Specification 111-50—Single-Conductor Insulated Wire and Cable With Flame-Retarding, Moisture-Resistant or Weather-Resistant Braid Covering or Outer Polychloroprene Sheath, Manual Part 186.

(Revision of A.A.R. Signal Section Specification 192-40)
A.A.R. SIGNAL SECTION SPECIFICATION 192-52.

INSULATED WIRE, A.V.C.

Proposed Revision

1. *Purpose.*

(a) This specification is for the purpose of providing for single-conductor signal wire insulated with varnished-cambric, felted asbestos and cotton braid saturated with flame, heat and moisture-resistant compound for use in weather protected locations and on circuits rated at 0-600 volts. It sets forth specific detail requirements representing modern signal practice recommended for new installations and for replacement on existing installations when general renewal or replacement becomes desirable.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Title and section 1-a of Specification 192-40—Single-Conductor, Asbestos Varnished-Cambric Insulated Signal Wire With Flame-Retarding Braid Covering, Manual Part 187.

(Revision of A.A.R. Signal Section Specification 169-48)
A.A.R. SIGNAL SECTION SPECIFICATION 169-52.

COPPER LINE WIRE

Proposed Revision

1. *Purpose.*

(a) This specification is for the purpose of providing for solid hard-drawn copper line wire, with or without weather-resistant covering, for use on signal circuits. It sets forth specific detail requirements representing modern signal practice recommended for new installations and for replacement on existing installations when general renewal or replacement becomes desirable.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Title and section 1-a of Specification 169-48—Hard-Drawn Copper Wire
With or Without Weather-Resistant Covering, Manual Part 182.

(Revision of A.A.R. Signal Section Specification 168-48)
A.A.R. SIGNAL SECTION SPECIFICATION 168-52.

COPPER ALLOY LINE WIRE

Proposed Revision

1. *Purpose.*

(a) This specification is for the purpose of providing for copper alloy line wire, A.S.T.M. Grade No. 30, with or without weather-resistant covering, for use on signal circuits. It sets forth specific detail requirements representing modern signal practice recommended for new installations and for replacement on existing installations when general renewal or replacement becomes desirable.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Title and section 1-a of Specification 168-48—Copper Alloy Wire
With or Without Weather-Resistant Covering, Manual Part 173.

(Revision of A.A.R. Signal Section Specification 167-48)
A.A.R. SIGNAL SECTION SPECIFICATION 167-52.

COPPER-COVERED STEEL LINE WIRE

Proposed Revision

1. *Purpose.*

(a) This specification is for the purpose of providing for copper-covered steel line wire, 30 and 40 per cent conductivity, with or without weather-resistant coverings, for use on signal circuits. It sets forth specific detail requirements representing modern signal practice recommended for new installations and for replacement on existing installations when general renewal or replacement becomes desirable.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Title and section 1-a of Specification 167-48—Copper-Covered Steel Wire
With or Without Weather-Resistant Coverings, Manual Part 180.

(Revision of A.A.R. Signal Section Specification 196-48)
A.A.R. SIGNAL SECTION SPECIFICATION 196-52.

COPPER-BEARING STEEL LINE WIRE

Proposed Revision

1. *Purpose.*

(a) This specification is for the purpose of providing for galvanized copper-bearing steel line wire, with or without weather-resistant covering, for use on signal circuits. It sets forth specific detail requirements representing modern signal practice recommended for new installations and for replacement on existing installations when general renewal or replacement becomes desirable.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Title and section 1-a of Specification 196-48—Copper-Bearing Steel Wire
With or Without Weather-Resistant Covering, Manual Part 181.

(Revision of A.A.R. Signal Section Specification 108-47)
A.A.R. SIGNAL SECTION SPECIFICATION 108-52.

COPPER BOND WIRE

Proposed Revision

1. *Purpose.*

(a) This specification is for the purpose of providing for No. 6 A.W.G. copper wires for bonding rail joints for track circuit use. It sets forth specific detail requirements representing modern signal practice recommended for new installations and for replacement on existing installations when general renewal or replacement becomes desirable.

2. *Conductor.*

(a) The conductor shall be annealed copper, and have properties and characteristics in accordance with A.S.T.M. current Specification B 3 pertaining to conductor and as required by this specification. The wire shall be cut and straightened to the length specified on order. The ends shall be sheared-cut and free from burrs.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Sections 1-a and 2-a of Specification 108-47—Copper Bond Wire,
Manual Part 175.

(Revision of A.A.R. Signal Section Specification 70-47)
A.A.R. SIGNAL SECTION SPECIFICATION 70-52.

COPPER-COVERED STEEL BOND WIRE

Proposed Revision

1. *Purpose.*

(a) This specification is for the purpose of providing for No. 6 A.W.G. forty per cent conductivity copper-covered steel wires for bonding rail joints for track circuit use. It sets forth specific detail requirements representing modern signal practice recommended for new installations and for replacement on existing installations when general renewal or replacement becomes desirable.

2. *Conductor.*

(a) The conductor shall be composed of a steel core with a copper coat concentrically placed around and permanently welded thereto. The conductor shall be cylindrical in form and free from scales, flaws, inequalities, splits and all imperfections not consistent with good commercial practice. The wire shall be cut and straightened to length specified on order and be thoroughly annealed. The ends shall be sheared-cut and free from burrs.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Title and sections 1-a and 2-a of Specification 70-47—Forty Per Cent Conductivity Copper-Covered Steel Bonding Wire, Manual Part 176.

WIRE INSPECTION REPORT

As this subject-matter serves no useful purpose, it is recommended it be removed from Manual Part 178.

Action Recommended

Acceptance for submission to letter ballot for removal from the Manual. (Manual Part 178.)

(Revision of A.A.R. Signal Section Specification 22-46)
A.A.R. SIGNAL SECTION SPECIFICATION 22-52.

GALVANIZED E.B.B. STEEL BOND WIRE

Proposed Revision

1. *Purpose.*

(a) This specification is for the purpose of providing for No. 8 B.W.G. galvanized steel wires for bonding rail joints for track circuit use. It sets forth specific detail requirements representing modern signal practice recommended for new installations and for replacement on existing installations when general renewal or replacement becomes desirable.

2. *Conductor.*

(a) The conductor must be cylindrical in form, free from scales, flaws, inequalities, splits and all imperfections. The con-

2. *Conductor*.—Continued.

ductor shall be cut and straightened to the length specified on order. The ends shall be sheared-cut and free from burrs.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Sections 1-a and 2-a of Specification 22-46—Galvanized E.B.B. Steel Bond Wire, Manual Part 177.

(Revision of A.A.R. Signal Section Specification 54-39)
A.A.R. SIGNAL SECTION SPECIFICATION 54-52.

ALUMINUM CABLE STEEL REINFORCED LINE WIRE

*Proposed Revision*1. *Purpose*.

(a) This specification is for the purpose of providing for aluminum cable steel reinforced for line wire. It sets forth specific detail requirements representing modern signal practice recommended for new installations and for replacement on existing installations when general renewal or replacement becomes desirable.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Title and section 1-a of Specification 54-39—Aerial Aluminum Cable Steel Reinforced, Manual Part 24.

SPECIFICATION FOR VITRIFIED CLAY CONDUIT

As the Specification for Vitrified Clay Conduit no longer appears in the Manual of the A.R.A. Telegraph and Telephone Section, now known as A.A.R. Communications Section, it is recommended that reference sheet, Manual Part 41, be removed from the Signal Section Manual.

Action Recommended

Acceptance for submission to letter ballot for removal from the Manual. (Manual Part 41.)

COOPERATIVE REPORT

AMERICAN SOCIETY FOR TESTING MATERIALS
SUBCOMMITTEE IX—INSULATING TAPES (COMMITTEE D-11—
RUBBER INSULATING MATERIALS)*

W. W. Beard, Representative

A meeting of A.S.T.M. Committee D-11 was held in Cleveland, Ohio, on March 5, 6 and 7, 1952.

Subcommittee IX met on March 6 at which time a proposed specification for ozone resistant rubber insulating tape similar to D-119-48T was considered. After considerable discussion on the method of testing for ozone resistance, the specification was held in abeyance pending further revision.

An item of interest to the Signal Section, and Signal Section Committee IX in particular, is revisions to A.S.T.M. Specification D-27-50T, Insulated Wire and Cable, Class AO. The details of the recommended revisions authorized for submission to letter ballot of Committee D-11 cover a revision to Table 1 on physical test requirements for insulation before and after aging tests. This revision, if adopted, may necessitate revisions of A.A.R. Signal Section wire and cable specifications.

Action Recommended

Acceptance as information.

* Previous report on this subject appears in A.A.R. Signal Section 1948 Proceedings, Vol. XLVI, pp. 362 and 475.

COMMITTEE X—SIGNALING PRACTICE

Personnel

G. K. Thomas, Chairman	
W. G. Salmonson, Vice-Chairman	
J. A. Beoddy	S. W. Law
C. M. Bishop	H. G. Morgan
J. J. Corcoran	S. E. Noble
E. N. Fox	W. S. Storms
H. B. Garrett	L. C. Walters
W. N. Hartman	J. S. Webb
T. W. Hays	W. W. Welsh

Signal Section, A.A.R.:

The following outline of work has been assigned:

1. Revision of Manual.
2. Indexing signal literature.
3. Report on noteworthy changes in signal practices.
4. Recommend uniform signal practice in the use of aspects and indications for railway signaling.
5. Requisites for automatic train control, automatic stop and cab signal systems.
6. Investigate and report on new and improved signal devices and related appliances.
7. Investigate and report on light out protection.
8. Investigate and report on the practicability of developing a portable speed recorder for determination of the speed of a passing train by direct reading.

The Committee submits for consideration, reports on the following subjects*:

1. Revision of Requisites for Centralized Traffic Control, Manual Part 86.
Revision of Signaling for Gravity Classification Yards, Manual Part 42.
3. Noteworthy changes in signal practices.
6. New and improved signal devices and related appliances.

Disposition of 1951 Letter Ballot Subjects

The following subjects presented by Committee X at the 1951 Annual Meeting were submitted to letter ballot and officially approved:

- Requisites for Protection for Spring Switches—Now in Manual Part 10.
Requisites for Automatic Block Signaling Systems—Now in Manual Part 87.
Requisites for Take or Leave Siding Indicator—Now in Manual Part 71.
Requisites for Interlocking—Now in Manual Part 94.

* Suggestions or criticisms should be submitted in writing to the Chairman of the Committee on or before September 1, 1952.

(Revision of Requisites for Centralized Traffic Control)
A.A.R. SIGNAL SECTION REQUISITES.

TRAFFIC CONTROL SYSTEMS

1952

1. These requisites are for the purpose of setting forth the recommended general requirements for traffic control systems. They set forth specific detail requirements representing modern signal practice recommended for new installations and for replacement of existing installations when general renewal or replacement becomes desirable.

2. All control circuits, the functioning of which affects safety of train operation, shall be designed on the closed circuit principle, except circuits for roadway equipment of intermittent automatic train stop system.

3. Each roadway signal shall be located over or to the right of the track it governs.

4. Aspects shall be shown by the position of semaphore blades, color of lights, position of lights, flashing of lights, or any combination thereof. They may be qualified by marker plate, number plate, letter plate, marker light, shape and color of semaphore blades, or any combination thereof, subject to the following conditions:

(a) Night aspects of roadway signals, except qualifying appurtenances, shall be shown by lights; day aspects by lights or semaphore arms. A single white light shall not be used.

(b) The fundamental indications of signal aspects shall conform to the following:

1. A red light, a series of horizontal lights, or a semaphore blade in a horizontal position shall be used to indicate Stop.

2. A yellow light, a lunar light, or a series of lights or a semaphore blade in the upper or lower quadrant at an angle of approximately 45 deg. to the vertical, shall be used to indicate that speed is to be restricted and stop may be required.

3. A green light, a series of vertical lights, or a semaphore blade in a vertical position in the upper quadrant, or 60 or 90 deg. in the lower quadrant shall be used to indicate Proceed at Authorized Speed.

5. Each roadway signal shall be located with respect to the next signal or signals in advance which govern train movements in the same direction so that the indication of a signal displaying a restrictive aspect can be complied with by means of a brake application, other than an emergency application, initiated at such signal, either by stopping at the signal where a stop is required, or by a reduction in speed to the rate prescribed by the next signal in advance where reduced speed is required.

6. A failure of a lamp in a light signal, or a semaphore signal arm assuming a false restrictive position, shall not cause the signal to display a more favorable indication than intended.

7. The battery or power supply for each signal control relay circuit, where

an open-wire line circuit or a common return circuit is used, shall be located at the end of the circuit farthest from the relay.

8. Signals governing movement at higher than restricted speed shall be controlled by continuous track circuits extending through the entire block. Also, in addition, at controlled point they shall be controlled by control operator, and, at manually operated interlocking, manually in cooperation with control operator.

9. On track signaled for movements in both directions, occupancy of the track between opposing signals at adjacent controlled points shall prevent changing the direction of traffic from that which obtained at the time the track became occupied.

10. Signals at a controlled point shall be so interconnected that aspects to proceed cannot be displayed simultaneously for conflicting movements.

11. Signals at adjacent controlled points shall be so interconnected that aspects to proceed cannot be displayed simultaneously for conflicting movements.

12. Signals governing movements over switches shall be so controlled that indications to proceed can be displayed only when such switches are in proper position.

13. Means shall be provided to insure that after a signal has been cleared, and the locking is effective, it cannot be restored manually to Stop by the operation of any lever other than its controlling lever.

14. Signal governing movements over hand-operated switch in the facing direction shall display its most restrictive aspect when the normally closed point is open $\frac{1}{4}$ in. or more and, in the trailing direction, $\frac{3}{8}$ in. or more, except that where a separate aspect is displayed for facing movements over the switch in the normal and in the reverse position, the signal shall display its most restrictive aspect when the switch points are open $\frac{1}{4}$ in. or more from either the normal or reverse position.

15. At hand-operated crossover between main track, protection shall be provided by one of the following:

(a) An arrangement of one or more track circuits, and switch circuit controllers.

(b) Facing point locks on both switches of the crossover, with both locks operated by a single lever.

(c) Electric locking of the switches of the crossover.

16. Signals governing movements over either switch of the crossover shall display their most restrictive aspect when any of the following conditions exist:

(a) Where protection is provided by one or more track circuits and switch circuit controllers, and either switch is open or the crossover is occupied by a train, engine, or car, in such a manner as to foul the main track.

(b) Where facing point locks with a single lever are provided, and either switch is unlocked.

(c) Where the switches are electrically locked, before the electric locking releases.

17. The circuits shall be so installed that each signal governing train movements into a block will display its most restrictive aspect when any of the following conditions obtains within the block:

- (a) Occupancy by a train, engine, or car.
- (b) When points of a switch are not closed in proper position.
- (c) When an independently operated fouling point derail equipped with switch circuit controller is not in derailing position.
- (d) When a track relay is in de-energized position, or when signal control circuit is de-energized.

18. The control circuit for power-operated or slotted mechanical signal, governing movements at higher than restricted speed over switches, movable point frogs, and derails, shall be selected through circuit controller operated directly by switch points or by switch locking mechanism, or through relay controlled by such circuit controller, for each switch, movable point frog, and derail in the routes governed by such signal. Circuits shall be so arranged that such signal can display an aspect to proceed only when each such switch, movable point frog, and derail in the route is in proper position.

19. Indication locking shall be provided for operative approach signals of the semaphore type, power-operated home signals, power-operated switches, movable point frogs and derails, and for all approach signals, except light signals all aspects of which are controlled by coded track circuits or by double-wire line circuits.

20. A signal shall be provided on main track to govern the approach with the current of traffic to any home signal except where the home signal is the first signal encountered when leaving yard or station and authorized speed approaching such signal is not higher than slow speed. When authorized speed between home signals on route governed is 20 miles per hour or less, an in-operative signal displaying an aspect indicating "approach next signal prepared to stop" may be used to govern the approach to the home signal.

21. The control circuits for aspects with indications more favorable than "proceed at restricted speed" shall be selected through track relays for all track circuits in the route governed or through repeating relays for such track relays. At automatic interlocking, signal control circuit shall be selected:

- (a) Through track relays for all track circuits in the route governed and in all conflicting routes within interlocking limits or through repeating relays for such track relays.
- (b) Through signal mechanism contacts or relay contacts closed when signals for such conflicting routes display stop aspects.
- (c) Through normal contacts of time releases for such conflicting routes or contacts of relays repeating the normal position of contacts of such time releases.

22. Signal control and electric locking circuits shall not be selected through the contacts of instruments designed primarily for indicating or annunciating purposes in which an indicating element attached to the armature is so arranged that it can in itself cause improper operation of the armature.

23. Occupancy of track circuits at controlled points shall be automatically indicated at the control station.

24. Approach or time locking shall be provided for all controlled signals and for all electric locks on hand-operated switches.

25. Route locking shall be provided where switches are power-operated.
26. Means shall be provided to indicate on the control machine when power-operated switch has completed its movement and is locked.
27. Each hand-operated switch in main track where train movements are made at speeds exceeding 20 miles per hour shall be electrically locked in normal position. Hand-operated switch electrically locked shall be operative as provided for in Requisites for Electric Locks Applied to Hand-Operated Switches for Protection of Main Track Movements, Manual Part 211.
28. Spring switches shall conform to Requisites for Protection for Spring Switches, Manual Part 10.
29. Take or leave siding indicators shall conform to Requisites for Take or Leave Siding Indicator, Manual Part 71.
30. Devices for providing protection against dragging equipment shall conform to Requisites for Dragging Equipment Detection, Manual Part 217.
31. Devices for providing protection against slides and rock falls shall conform to Requisites for Protection of Traffic Against Slides and Rock Falls, Manual Part 205.
32. Devices for providing protection against burned bridges or trestles, high-water hazards, and other similar protective devices shall be arranged to operate in conformity with the traffic control system.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Requisites for Centralized Traffic Control, Manual Part 86.

2. Locomotive equipped with cab signal may be placed in operating pools regardless of the track energy used in the territory involved.

3. Railroads using d.c. coded track circuits to control wayside signals can utilize the same coding for cab signal control.

4. By using coded d.c. track circuits fed by primary battery, cab signals can be extended into areas where a.c. energy is not obtainable.

This is a development of the General Railway Signal Co.

Eight New Types of Devices

Plug-in type biased code following relay, Style PCD.

This is a compact rugged type of two-position biased code following plug-in relay. It is the plug-in equivalent of the standard shelf type Style CD code following relay both in electrical operation and maximum contacts available (four front and four back non-independent contacts). Numerous new design features are incorporated in this relay which makes for compactness, ruggedness, and ease of adjustment. This relay, like the Style CD, is trunnionless and free from wearing parts, which insures long trouble-free life.

The relay is $5\frac{1}{8}$ inches wide, 8 inches high, and $7\frac{1}{2}$ inches deep, with $1\frac{5}{8}$ inches additional depth taken up by the handle in the front.

This is a development of the Union Switch & Signal Div., Westinghouse Air Brake Co.

Plug-in type magnetic stick code following relay, Style PCDP.

This is a two-position magnetic stick code following plug-in relay. It is the equivalent plug-in of the standard shelf type Style CDP both in electrical operation and maximum available contacts (four normal and four reverse contacts). The same design features as the Style PCD relay, and the same size.

This is a development of the Union Switch & Signal Div., Westinghouse Air Brake Co.

Three-position shelf type code following relay, Style CDD.

This new type of code following relay is so arranged that one set of contacts (two normal front and back) will follow code of positive polarity only and another set of contacts (two reverse front and back) will follow code of negative polarity only. This relay is capable of following alternate pulses of positive and negative code so that both sets of contacts can be made to operate during a code frequency cycle. It is the same size and operates on the same power as the standard two-position Style CD relay. Like the CD relay it is of the trunnionless type and free from wearing parts which insures long trouble-free life. It can be furnished for either line or track operation. It may be used to obtain a multiplicity of indications over a single pair of line wires (four indications may be obtained over a single pair of line wires) from a single code frequency with a simple decoding arrangement. Additional indications can be obtained over a single pair of line wires by using additional code frequencies and frequency decoding.

This is a development of the Union Switch & Signal Div., Westinghouse Air Brake Co.

25. Route locking shall be provided where switches are power-operated.
26. Means shall be provided to indicate on the control machine when power-operated switch has completed its movement and is locked.
27. Each hand-operated switch in main track where train movements are made at speeds exceeding 20 miles per hour shall be electrically locked in normal position. Hand-operated switch electrically locked shall be operative as provided for in *Requisites for Electric Locks Applied to Hand-Operated Switches for Protection of Main Track Movements, Manual Part 211.*
28. Spring switches shall conform to *Requisites for Protection for Spring Switches, Manual Part 10.*
29. Take or leave siding indicators shall conform to *Requisites for Take or Leave Siding Indicator, Manual Part 71.*
30. Devices for providing protection against dragging equipment shall conform to *Requisites for Dragging Equipment Detection, Manual Part 217.*
31. Devices for providing protection against slides and rock falls shall conform to *Requisites for Protection of Traffic Against Slides and Rock Falls, Manual Part 205.*
32. Devices for providing protection against burned bridges or trestles, high-water hazards, and other similar protective devices shall be arranged to operate in conformity with the traffic control system.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the *Manual*.

Subject-matter to be Superseded

Requisites for Centralized Traffic Control, Manual Part 86.

(Revision of Signaling for Gravity Classification Yards)

SIGNALING FOR GRAVITY CLASSIFICATION YARDS

1952

1. At yards where all cars are weighed when being classified, hump signals which display three indications are recommended.
2. At yards where none or only a part of the cars being classified are weighed, hump signals which display either four or five indications are recommended.
3. Color light signals.

Aspect	Indication
Red	Stop
Green	Proceed at normal hump speed
Yellow over yellow or Flashing yellow	Proceed at medium hump speed
Yellow	
Flashing red	Back up

Aspects and indications of signals of types other than color light shall be the equivalent of those shown.

4. Local conditions shall govern the number of repeater hump signals to be used.

5. In yards where it is necessary to make movements over humps from classification tracks, trimmer signals shall be provided and interconnected with hump signal and its repeaters so as to prevent hump operation while trimming movements are being made, except that circuit may be provided to permit trimmer movements while train is approaching hump. Trimmer signals which display two indications are recommended.

Color Light Signals

Aspect	Indication
Red	Stop
Yellow	Trim

Aspects and indications of signals of types other than color light shall be the equivalent of those shown.

6. Where cab signals are used their aspects and indications shall be in accordance with those for hump signals.

7. Where audible signals are used, in addition to visual signals, a code of sounds must be used which will provide a distinct indication to correspond to each visual indication, and must not be in conflict with Standard Code Rule 606.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Signaling for Gravity Classification Yards, Manual Part 42.

NOTEWORTHY CHANGES IN SIGNAL PRACTICES*

Signaling for siding tracks in traffic control territory.

To expedite train movements, bring about non-stop meets, and to permit better handling of long freight trains into and out of sidings, many roads are finding it practicable to install signaling on sidings and to provide signal indications that are less restrictive than formerly used.

Many installations in the past have been made in which the move into and through the siding has been under the "restricting" aspect, Standard Code Rule 290.

Some roads now install track circuits on the sidings and use the "slow-approach" aspect, Rule 288, or the "slow-clear" aspect, Rule 287, depending upon track occupancy.

Other roads have installed medium speed turnouts with track-circuited sidings and make use of the "medium-approach" aspect, Rule 286, or where extra long sidings are provided with intermediate signals thereon, the "medium-clear" aspect, Rule 283, is used, depending upon track occupancy.

Action Recommended

Acceptance as information.

NEW AND IMPROVED SIGNAL DEVICES AND
RELATED APPLIANCES†

It should be understood that this is solely a report to inform the members of the availability of the various devices mentioned therein, and what the manufacturers claim they will do. It is submitted as information—it does not constitute any Signal Section recommendation.

Multiple aspect cab signal system.

A new multiple aspect of cab signal system which may be used with d.c. half-wave rectified a.c. and a.c. coded track circuits has been developed. When a.c. coded track circuits are used, standard 60 cycle a.c. may be employed as the source of energy. It is not necessary to supply special frequencies such as 100 cycles. The same locomotive equipment serves for all applications and requires no switching or adjustment when changing from one type of coded track energy to another.

Additional benefits are:

1. Locomotive can operate over routes in which both a.c. and d.c. coded track circuits occur.

* Previous report on this subject appears in A.A.R. Signal Section 1949 Proceedings, Vol. XLVII, pp. 248 and 341.

† Previous report on this subject appears in A.A.R. Signal Section 1950 Proceedings, Vol. XLVIII, pp. 326 and 398.

2. Locomotive equipped with cab signal may be placed in operating pools regardless of the track energy used in the territory involved.

3. Railroads using d.c. coded track circuits to control wayside signals can utilize the same coding for cab signal control.

4. By using coded d.c. track circuits fed by primary battery, cab signals can be extended into areas where a.c. energy is not obtainable.

This is a development of the General Railway Signal Co.

Eight New Types of Devices

Plug-in type biased code following relay, Style PCD.

This is a compact rugged type of two-position biased code following plug-in relay. It is the plug-in equivalent of the standard shelf type Style CD code following relay both in electrical operation and maximum contacts available (four front and four back non-independent contacts). Numerous new design features are incorporated in this relay which makes for compactness, ruggedness, and ease of adjustment. This relay, like the Style CD, is trunnionless and free from wearing parts, which insures long trouble-free life.

The relay is $5\frac{1}{8}$ inches wide, 8 inches high, and $7\frac{1}{2}$ inches deep, with $1\frac{5}{8}$ inches additional depth taken up by the handle in the front.

This is a development of the Union Switch & Signal Div., Westinghouse Air Brake Co.

Plug-in type magnetic stick code following relay, Style PCDP.

This is a two-position magnetic stick code following plug-in relay. It is the equivalent plug-in of the standard shelf type Style CDP both in electrical operation and maximum available contacts (four normal and four reverse contacts). The same design features as the Style PCD relay, and the same size.

This is a development of the Union Switch & Signal Div., Westinghouse Air Brake Co.

Three-position shelf type code following relay, Style CDD.

This new type of code following relay is so arranged that one set of contacts (two normal front and back) will follow code of positive polarity only and another set of contacts (two reverse front and back) will follow code of negative polarity only. This relay is capable of following alternate pulses of positive and negative code so that both sets of contacts can be made to operate during a code frequency cycle. It is the same size and operates on the same power as the standard two-position Style CD relay. Like the CD relay it is of the trunnionless type and free from wearing parts which insures long trouble-free life. It can be furnished for either line or track operation. It may be used to obtain a multiplicity of indications over a single pair of line wires (four indications may be obtained over a single pair of line wires) from a single code frequency with a simple decoding arrangement. Additional indications can be obtained over a single pair of line wires by using additional code frequencies and frequency decoding.

This is a development of the Union Switch & Signal Div., Westinghouse Air Brake Co.

Style PD-20 code meter.

This is a portable multi-scale a.c.-d.c. meter which has been developed to meet practically all of the requirements in the railway signal field. It has a.c. voltage ranges from 2.5 to 250 with a full scale resistance of 1,000 ohms per volt, which makes it usable even on relatively high impedance circuits such as are encountered on line or carrier circuits. The d.c. voltage ranges are from 1 to 500 with a full scale resistance of 2,000 ohms per volt. The d.c. current ranges are from 0.010 to 25 amperes with reasonably low resistance so that the insertion of this meter will not appreciably affect the circuit characteristics. Numerous special features are incorporated, such as a needle stop for measuring peak values of code, and "on time" scale for measuring the percentage of time a contact is closed and special damping scales used for measuring rectifier currents.

This meter is a development of the Union Switch & Signal Div., Westinghouse Air Brake Co.

Biased neutral relay, Style PN-67B.

A new highly efficient plug-in biased neutral relay, Style PN-67B, has been developed as a decoding relay for coded wayside signaling systems. The relay uses a magnetic structure having two vertical coils in a case that is 50 per cent wider than the PN-50B relay. Contact equipment is 6F-6B dependent L.V.—calibration values are the same as the DN-11 four-point relay. The high operating efficiency of this relay is expected to be found useful in other applications.

This relay is a development of the Union Switch & Signal Div., Westinghouse Air Brake Co.

Slow pick-up biased neutral relay, Style PN-68B.

A new plug-in type of slow pick-up biased neutral line relay, Style PN-68B, has been developed. This relay is a slow pick-up ordinary drop-away type that is particularly suitable for use as a repeater of the track relay to overcome intermittent loss of shunt and "joint hopping" problems. Pick-up time is 1 second and drop-away time is 0.05 second at the normal rated voltage. Timing characteristics are similar to the shelf type Style DN-18 slow pick-up ordinary drop-away relay. It is the same size and carries the same contact equipment as the PN-67B.

This relay is a development of the Union Switch & Signal Div., Westinghouse Air Brake Co.

Biased neutral track relay, Style PN-50BH.

A new plug-in biased neutral track relay known as the PN-50BH relay has been developed for steady energy d.c. track circuit application. It is the plug-in equivalent of the well-known shelf type Style DN-22BH relay in calibration values and operating characteristics. This relay is the same size as the Style PN-50B (formerly the PN-50), but is equipped with a two-coil magnetic structure and 2F-2B independent L.V. contacts. The biased neutral feature, together with high drop-away ratio of this relay, results in the nearest practical approach to the ideal track relay for steady energy d.c. track circuits.

This relay is a development of the Union Switch & Signal Div., Westinghouse Air Brake Co.

Two-rate charge control unit, Style DNL-47.

A new two-rate charge control unit, designated DNL-47, is now available. This unit consists of a DNL-46 two-rate charge relay and an additional L relay mounted in a compact arrangement that requires no more shelf area than the DNL-46 relay only. The use of the additional L relay results in a reduction in battery drain in case of power failure and during trickle charge because the DNL-46 relay is disconnected from the battery under either of these conditions. The stand-by time of the battery is thereby increased.

This unit is a development of the Union Switch & Signal Div., Westinghouse Air Brake Co.

Automatic train identification and routing systems.

With these systems trains automatically register their destination and class as they pass selected wayside locations. The systems are designed for use at switching locations where traffic is heavy and trains follow each other at short intervals such as in rapid transit or commuting service. They make possible many new types of operation, one of which would be to enable a train to line up its own route without the attention of the interlocking operator.

The train-carried equipment consists only of a coil and tuning condenser, the coil being so mounted that it will be inductively coupled with the similar coil or coils on the wayside when it passes the wayside location.

The train loops are simple assemblies requiring no energy. Train identities can be changed readily by merely changing loops.

These systems are sensitive only to train loops and are not affected by masses of metal such as steel cars, wheels, etc.

Both the Union Switch & Signal Division of the Westinghouse Air Brake Co. and the General Railway Signal Co. have developed systems of this kind.

Solderless terminals.

A new method for attaching lead wires to relays and binding posts without the use of solder has been developed.

1. Pre-insulated solderless terminals.

This specialized AMP terminal is designed for intricate wiring systems where a flag type, body insulation, and end-on crimping are all advantageous. The installation can be completely made with one stroke of a precision tool. They are available in color-coded wire size ranges from No. 22 to No. 10.

2. Plasti-bond solderless terminals.

AMP's new design insures that no underlying conducting surface will be exposed even in case the outer plastic covering of this terminal should be pierced accidentally by faulty installation. This is accomplished by means of an isolated ring of copper bonded near the base of the insulation support sleeve. The ring gives all necessary strength to combat vibration and sharp bending, but does not communicate with the electrical connection farther up the barrel. Result is an insulated terminal that can be installed with one stroke of a tool.

These are developments of Aircraft-Marine Products, Inc.

Action Recommended

Acceptance as information.

COMMITTEE XI—ELECTRONICS

Personnel

J. I. Kirsch, Chairman

E. F. Brown, Vice-Chairman

A. B. Armistead	R. M. Laurenson
P. B. Burley	N. J. Morrisson, Jr.
T. L. Carlson	E. J. Muckerheide
J. R. DePriest	J. Ryscuck
L. H. Dyke	H. H. Seifert
H. T. Fleisher	V. O. Smeltzer
C. E. Hanert	T. B. Thompson
A. J. Hendry	T. W. Wigton
J. M. Hesser	A. V. Dasburg*
J. E. Hillig	C. B. Shields*
J. M. Hoover	F. H. Menagh*

Signal Section, A.A.R.:

The following outline of work has been assigned:

1. Revision of Manual.
2. Indexing signal literature.
3. Investigate and report on the use of electronic controls for railway signaling.
4. Report on electronic measuring apparatus applicable to railway signaling.
5. Principles of vacuum tubes, carrier systems and other electronic systems and devices.
6. Recommend basic design principles for electronic controls for railway signaling systems.
7. Investigate and report on the effects to both signal controls and communications when superimposing centralized traffic control circuits on existing dispatchers or other communication circuits, collaborating with Communications Section, A.A.R.
8. Electronic tubes for use in signal apparatus, recommendation to cover type and designations of tubes to meet various requirements.
9. Investigate and report on the use of electronic switches in lieu of electromagnetic relays.
10. Investigate and report on the attenuation of open wire pairs and of cable pairs at frequencies up to 75 kilocycles.

The Committee submits for consideration, reports on the following subjects**:

3. Train identification.

Electronic cut-off for pedestrian warning signal.

* Consulting Member.

** Suggestions or criticisms should be submitted in writing to the Chairman of the Committee on or before September 1, 1952.

4. Carrier level meter.
Line fault-finders.
 5. Considerations in the application of electronics.
 7. Mutual effects that may be encountered in combining circuits on a single pair of wires.
 10. Attenuation of open wire pairs and of cable pairs at frequencies up to 100 kilocycles.
- Cooperative report. Communications Section, A.A.R., Committee 4—Radio and Allied Communications.

MUTUAL EFFECTS THAT MAY BE ENCOUNTERED IN COMBINING CIRCUITS ON A SINGLE PAIR OF WIRES

Under certain conditions it may be feasible and desirable to combine communication and signal control and indication circuits on the same pair of wires. As there are many known ways of combining circuits on a single pair of wires, and undoubtedly a great many yet undiscovered ways, it will not be the purpose of this report to describe the combinations that might be used but rather to point out the mutual effects that are likely to be encountered so that design problems may be anticipated.

When planning circuit combinations the following factors should be given consideration:

1. *Crosstalk.*

(a) Coordination of frequencies by direction of transmission. Allocations of frequencies by direction of transmission should be in accordance with recommendation of A.A.R. Communications Section 2-J-46.

(b) Coordination of energy levels. High level circuits are liable to crosstalk into low level circuits. In general, circuits having somewhat similar energy levels and attenuation characteristics will produce a minimum of mutual interference.

(c) Quality of filters. Filters, if used, must have low attenuation to wanted frequencies and high attenuation to unwanted frequencies.

(d) Adequate separation of frequencies. Frequencies should be chosen so as not to place unreasonable requirements on filters.

(e) Interference from harmonics. Frequencies should preferably be such that no circuit operates at a frequency that is an exact multiple of the frequency of another circuit on the same line.

(f) Saturation of loading coils. Loaded cables should not handle currents in excess of the rating of the loading coils. Excessive current may cause saturation of the coil cores with resultant crosstalk.

(g) Interference from, or to, ringing devices. The use of ringing equipment including selectors and answer-backs, may introduce problems on circuits that would otherwise be free from crosstalk.

2. *Energy levels.*

(a) Equipment losses. The connecting of equipment for an added circuit normally increases attenuation of the original circuit. These losses may be severe enough that compensation of some kind is required.

2. *Energy levels.*—Continued.

(b) Impedance mismatches.

1. Source and load impedances must be essentially equal for all circuits on the line to prevent one circuit from draining excessive energy from another.

2. Intermediate devices such as filters, by-pass, and transfer equipment must be of substantially correct impedance.

3. Line discontinuities may introduce negligible losses in some circuits while producing appreciable losses in other circuits on the same line.

4. Branch lines, taps, or loops may add considerable loss to some circuits without introducing appreciable loss in others.

(c) Individual circuit termination. Devices used to terminate one circuit and continue another should introduce a minimum of attenuation in the continuing circuit.

(d) Repeater location. It is sometimes necessary to repeat one circuit on a line without repeating other circuits. A single repeater should theoretically be located at the electrical center of the circuit for maximum usable gain, but such a location may be highly undesirable in its effect on the other circuits. Before choosing a location for a repeater, full consideration should be given to the resultant effect upon all circuits on the line.

(e) Avoidance of critical energy levels. Circuits operating with ample margins may have these margins brought close to the vanishing point when an additional circuit is placed on the line. Under these conditions the fact that the original circuit continues to operate should not be accepted as evidence of satisfactory design.

3. *External interference.*

(a) Loss of balance. Equipment which is sufficiently well balanced for some circuits may be inadequate for other circuits on the same line, and may permit the introduction of external interference into the original circuit.

(b) Grounds. Addition of grounds for simplex circuits, composites, or drainage coils may introduce interference on one circuit without interfering with other circuits on the same line.

(c) Branch lines. The addition of branches, taps, or loops made necessary by additional circuits may add interference to existing circuits.

4. *Intermittent conditions.*

(a) Way station telephones. Intermittent use of way station telephones may cause varying attenuation on both the telephone circuit and on other circuits on the same line.

(b) Portable telephones. The possibility of portable telephones being connected to the line and the resulting bridging losses should be considered for each circuit on the line.

(c) Branch lines not continuously connected. Branch lines are sometimes patched to through lines for the duration of conversation. The connection may be made by an operator at the junction point or may be controlled remotely by selectors or other equipment. Unless properly designed such patches may introduce excessive attenuation to one or more of the circuits.

(d) Maintenance work. Lines known to have frequent outages are normally

4. *Intermittent conditions.*—Continued.

not desirable for handling multiple circuits because the total circuit outage time increases proportionately to the number of circuits on the line. Frequent maintenance work on equipment of one circuit may adversely affect other circuits on the line.

(e) Normally-off repeaters. Circuits are sometimes provided with stand-by repeaters arranged to be cut in under excessive attenuation conditions. With such an arrangement the effect on all circuits should be checked with repeater both in and out.

(f) Weather conditions. Long open wire lines are subject to wide variation of attenuation with changing weather conditions. Lines that are satisfactory for certain types of circuits under all weather conditions may be totally unsuited to other types of circuits under the same conditions.

(g) Patching to fall-back lines. Lines carrying multiple circuits are sometimes chosen because they are particularly suited to that use, or are treated to make them suitable. If it is contemplated that paralleling lines, or lines on alternate routes, are to be available as fall-back lines, it should be determined in advance that the alternate lines are capable of handling all the circuits on the normal line. Unless this is done it may be found that in emergencies the most important circuits are lost while less important ones remain in service.

5. *Operating characteristics.*

(a) Disadvantages of multiple-circuit lines.

1. The possibility of a circuit failure due to a line fault is greater on multiple circuit line than on a single circuit line.
2. Certain circuit combinations require time sequence or sharing for their operation.
3. At present there is no known way to eliminate interference caused from simultaneous operation of circuits, such as centralized traffic control code and field ringing.
4. Addition of equipment to a line normally increases liability of failure to both original and added circuits.

(b) Advantages of multiple-circuit lines.

1. Economy. Combining circuits often shows such marked installation and maintenance savings that a considerable amount of engineering can be justified if necessary to produce a satisfactory over-all design.
2. Fault detection. Addition of a second circuit to a line may be helpful in detecting a line fault that might otherwise continue unnoticed. This detection may be the result of the added circuit being more readily influenced by the particular type of fault, or by the second circuit being more frequently monitored. Such fault detection may permit clearing the trouble before failure actually occurs.
3. Reliability. Where a new line is required or an existing line is to be rebuilt, increased reliability might be obtained by consolidating several circuits on one strong line rather than using several weaker lines.

Action Recommended

Acceptance as information.

ATTENUATION OF OPEN WIRE PAIRS AND OF CABLE PAIRS
AT FREQUENCIES UP TO 100 KILOCYCLES

Tabulated attenuation data for open wire and cable pairs are available in a Federal Telephone and Radio Corporation publication, "Reference Data for Radio Engineers," Third Edition. These data have been plotted in curve form to show attenuation at frequencies up to 100 kilocycles for typical physical conditions. The curves for open wire pairs of copper and copperweld wire in wet and dry weather are shown in Figs. 1, 2, 3 and 4. Those for toll cable are shown in Fig. 5. (See pages 308 to 312.)

Differences may appear to exist between these and other published data. However, such discrepancies can generally be explained by the fact that the data are derived from different physical conditions. The attenuation varies as a function of poles per mile, pin spacing, type of insulator, temperature, etc. Therefore these must be defined for each set of attenuation tables or curves.

Some information on attenuation of steel and iron open wire pairs is available; however, it has not been included in this report because the conditions under which it was obtained are not adequately defined. A general statement can be made that attenuation for iron and steel wire is from ten to twelve times that for equivalent copper wire at frequencies between 3 and 50 kilocycles.

Action Recommended

Acceptance as information.

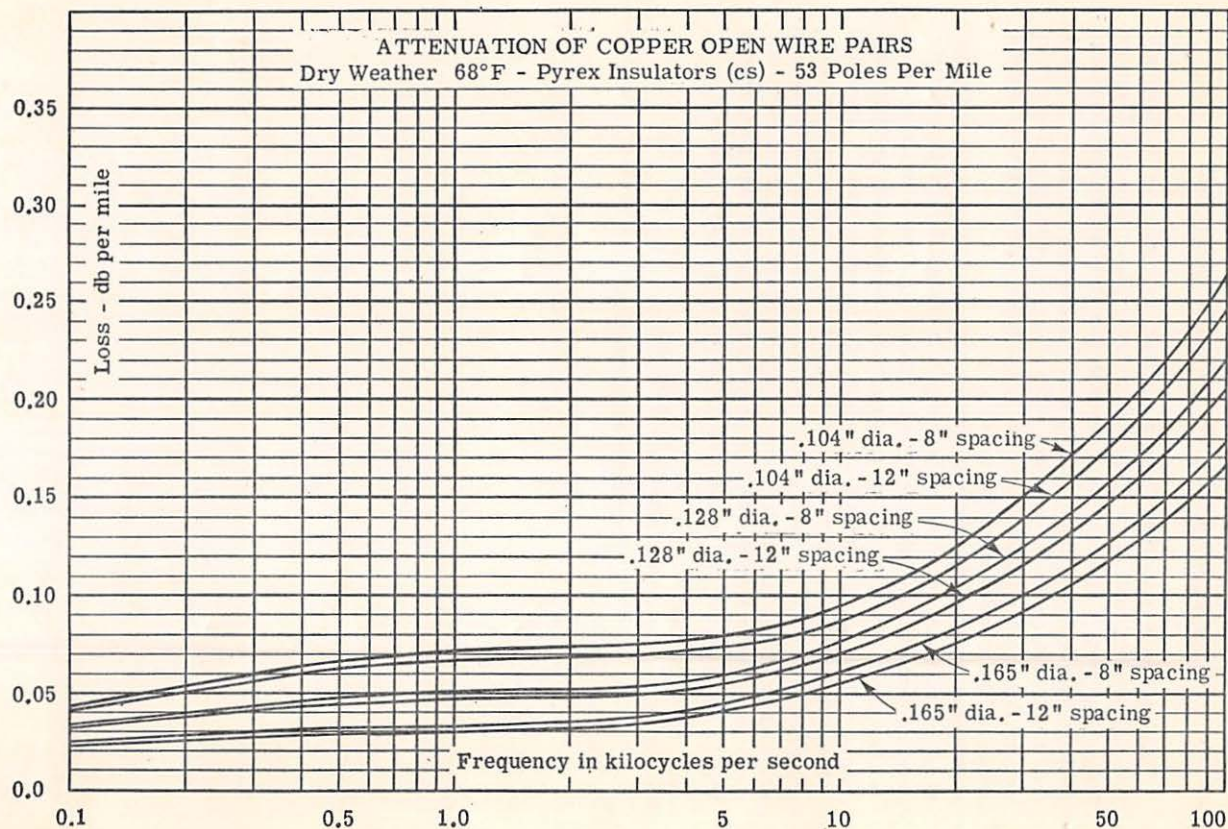


Fig. 1.

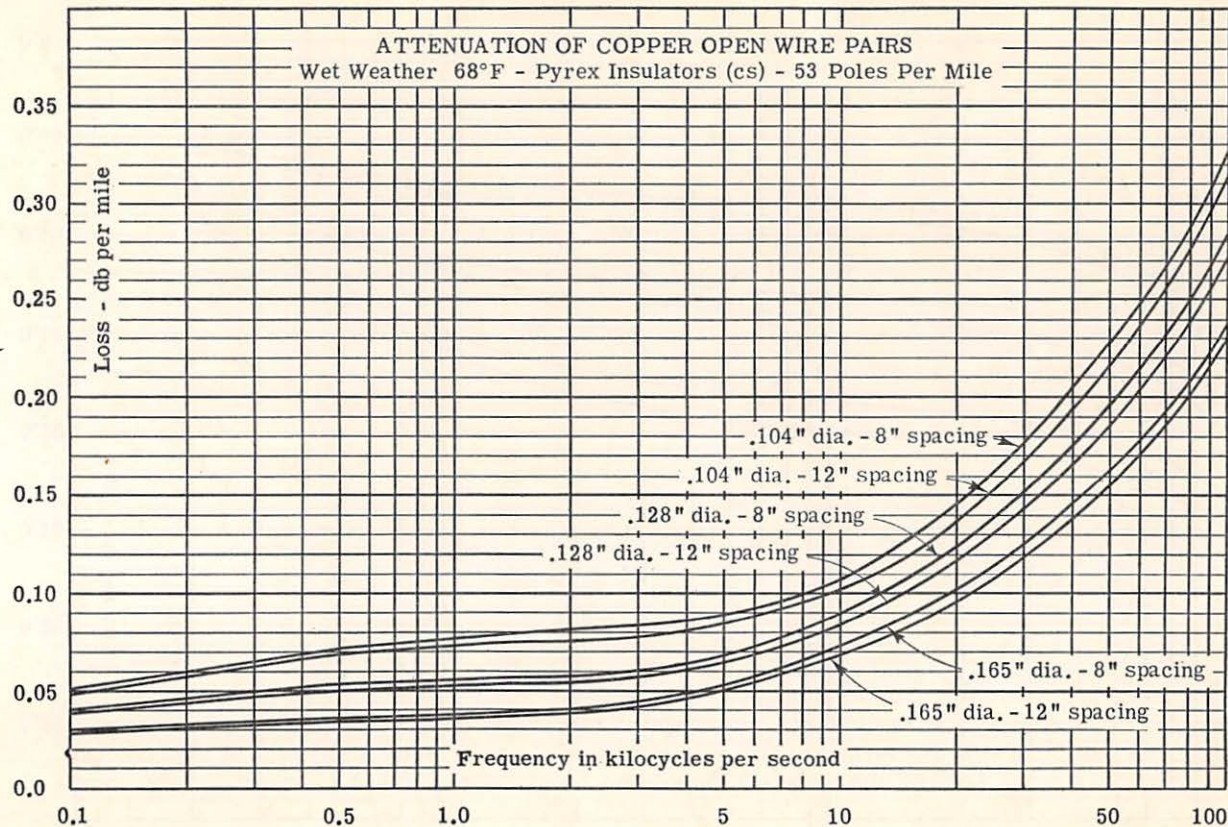


Fig. 2.

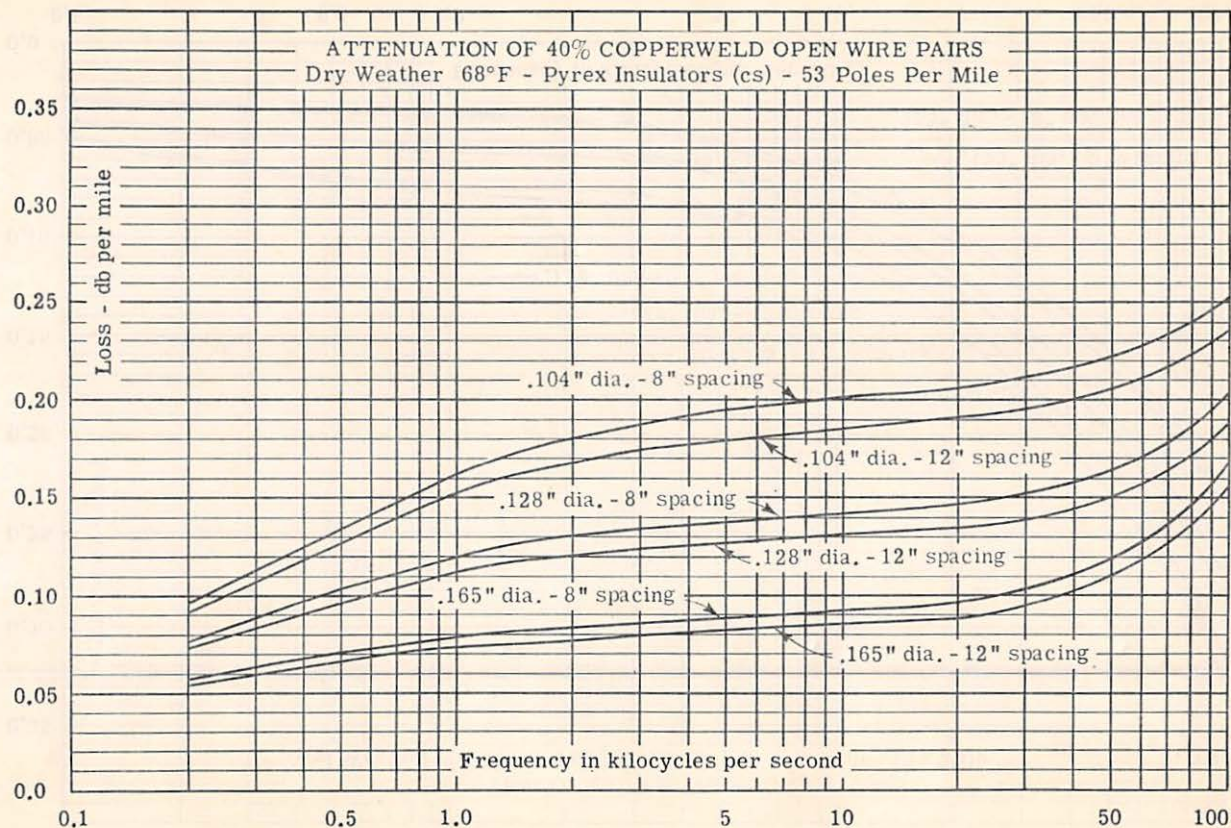


Fig. 3.

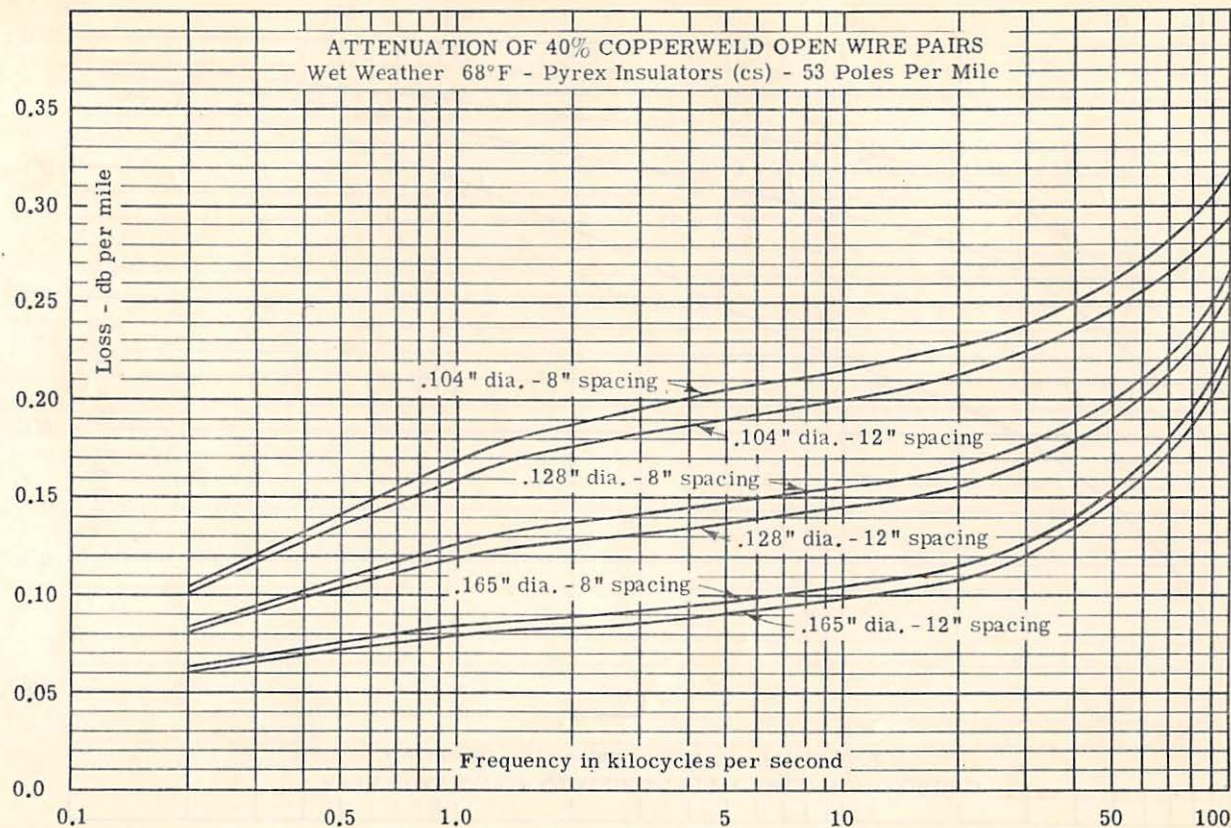


Fig. 4.

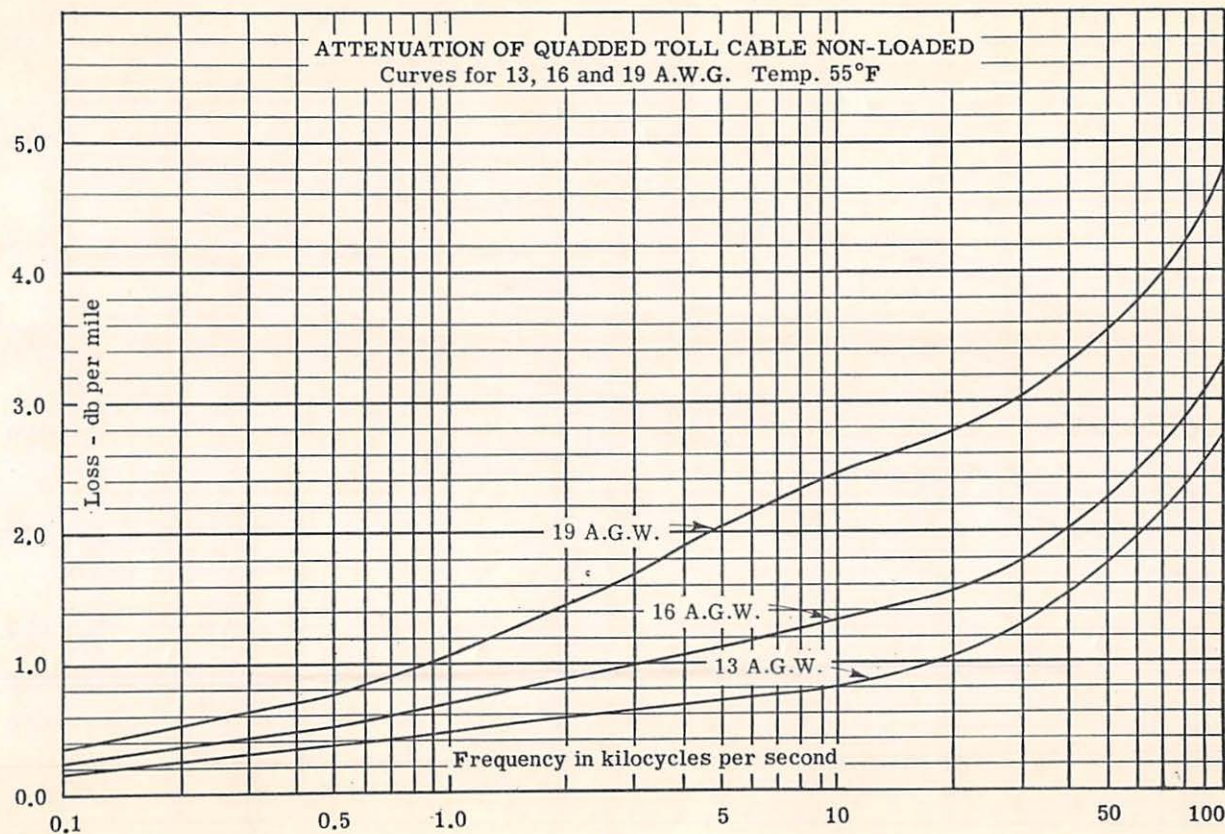


Fig. 5.

TRAIN IDENTIFICATION

Two systems for automatic train identification employing electronic controls have been recently developed. A description of these two systems is as follows:

Automatic train identification and routing system.

There are, on practically all railroads, locations at which trains must be switched to one or another of diverging routes. In order for an operator to line up the proper routes for such trains, he must, of course, know the identity of each train and its intended destination. On rapid transit lines, and on railroads operating commuter trains, this matter of train identification and routing can present a real problem, because traffic is heavy and trains follow each other at short intervals. An operator who has to identify such trains by means of their marker lights, by telephone messages, or by other means, and who must then set up the proper route for each, may find it difficult to keep up with the flow of traffic. It may happen, therefore, that delays occur in lining up routes and even, occasionally, that trains get misrouted giving rise to serious delays. To aid in the solution of this problem, an automatic train identification and routing system has been developed by which each train identifies itself and lines up its own route without the attention of the operator.

The system identifies trains by means of the effect of train-carried loops on a vacuum tube oscillator whose frequency is varied at a rapid rate over the approximate range of 100 to 300 kilocycles. The oscillator and related circuit elements are installed at a wayside location in advance of the first switch of the interlocking. One of the circuit elements included in this arrangement is a track coil of approximately 15-inch diameter, mounted between the rails, and excited with the variable-frequency output of the oscillator. Each train to be identified carries a tuned loop mounted underneath the locomotive or leading car. The resonant frequency of this loop identifies the train, and is of such value as to lie within the range of frequencies covered by the variable-frequency oscillator. As the train moves over the identification point, the train coil is momentarily coupled to the track coil, and produces a reaction in the oscillator circuits because of the energy transfer which takes place between the track and train coils.

The oscillator reaction is not, however, continuous during the entire time the train coil is passing over the track coil, since appreciable energy transfer between the wayside and train circuits occurs only when the rapidly varying oscillator frequency is in the immediate vicinity of the train-coil frequency. But at this frequency, the oscillator reaction is marked, even when the train coil and track coil are separated by the nominal clearance distance of 15 inches.

By means of suitable circuits, the oscillator reaction is used to develop a momentary pulse which is applied simultaneously to a group of relay control channels. These channels are arranged to remain cut off unless a gating voltage is also present. The gate is derived from a group of resonant circuits tuned to the same frequencies as the various train coils. Each of these resonant circuits causes the appearance of a gate as the oscillator moves past its frequency.

Each frequency-determining gate is applied individually to the particular relay-control channel associated with that frequency. A coincidence arrange-

ment is thus set up by which the appearance of an oscillator-reaction pulse on all relay control channels indicates the presence of a train loop, and the simultaneous appearance of a frequency-determining gate on one, and only one, of the relay-control channels identifies the frequency of the loop. The channel which receives both oscillator-reaction pulse and frequency-determining gate thereupon picks up an associated relay to identify the frequency of the passing train loop, and this information is then utilized by means of suitable circuits to line up the proper route for the train.

The circuits used to develop the oscillator-reaction pulse are so designed as to produce output only when the oscillator reaction is of an abrupt nature. This type of reaction is characteristically produced by resonant-circuits of sufficiently high Q (low loss), such as the train loops, but is not produced by random conducting objects. As a result, the wayside circuits do not respond to the passage of stray metallic objects, steel cars, wheels, drive motors, etc., which may pass by or over the track coil, even though such objects may be of considerable size, and be associated with magnetic fields of appreciable magnitude.

By using a four-frequency system (*i.e.*, four different frequencies for train loops with corresponding wayside frequency identification arrangements) combination of one or more train loops may be used to provide as many as 14 distinct identifications. The train identification features of the system may also be combined with route-storage circuits, so that the route for a number of trains may be stored and then fed out to route selection circuits as each train reaches the first switch in the interlocking. The circuits can also be arranged to actuate a wayside annunciator so that the engineman can see that his train has been correctly identified.

Some of the more important features of the system are summarized as follows:

1. Train loops are simple, economical assemblies requiring no energy. Train identities may be changed by exchange of loops.
2. Only one oscillator and one wayside coil are required for any practical number of frequencies. Use of sweep-frequency principle eliminates need for separate oscillators for each frequency.
3. Sweep-frequency operation eliminates need for oscillator stability required with a fixed-oscillator system. All frequency-identifying circuits are passive resonant circuits, inherently stable.
4. The system is sensitive only to tuned train loops, and operation is not affected by even large metallic masses, such as steel cars, wheels, etc.
5. Speed of identification is sufficiently great to provide positive identification of fastest moving trains.

Inductive train identification system.

With this system, trains automatically register their destination and class as they pass selected wayside locations. The system was developed primarily for service where trains operate on close headway as in rapid transit or commuting service to provide means for indicating the destination of approaching trains to the operators at interlockings and, in conjunction with illuminated signs or an automatic announcing system, to the public at station platforms. The system can also be used to provide automatic routing by using it in com-

bination with the principles of route interlocking. The train identification system also provides a facility that is needed in the application of remote control to rapid transit signaling.

The train-carried equipment consists only of a coil and tuning condenser, the coil being so mounted that it will be inductively coupled with the similar coils on the wayside when it passes the wayside location. The coils have a diameter of approximately 10 to 18 inches depending on the mounting arrangement on the train and the separation distance from the wayside coils. For multiple-unit type of trains, the coil and tuning condenser are arranged as a quickly detachable unit held in a bracket on the front car. The coil unit is quickly replaced by one of a different tuned frequency when it is desired to change the identification. An important advantage of this type of inductive system is that it does not require any electrical connections or source of energy on the train.

At each wayside location where trains are to be identified, a pair of coils similar to those on the train and in a fixed relationship to each other are mounted alongside the track. One of these coils is the transmitting coil that sets up the high frequency magnetic field in its vicinity and the other coil serves as a pick-up or receiving coil. For each identity to be registered at the location, there is an electronic unit consisting of a small conventional vacuum tube oscillator that generates the high frequency current applied to the transmitting coil, and an amplifier, thyatron tube, and relay, which operate in response to voltage of that same frequency in the receiver coil. Oscillator-amplifier units of several different frequencies operate in parallel on the same pair of wayside coils. The receiver coil is positioned so as not to have any appreciable coupling with the transmitter coil normally but when a tuned coil on a train is opposite the wayside coils, the coupling from wayside to train coil and back from the tuned train coil to the wayside receiver coil induces a voltage that is amplified and causes the thyatron to conduct and pick up the relay.

The amplifier system includes a phase discriminator circuit in which the voltage from the receiver coil is compared in phase with that from the oscillator. This discriminator circuit is so adjusted that the tuned coil produces a positive output voltage but a mass of metal such as the side of a car produces zero or negative output voltage and thus will not cause the thyatron to become conductive. This arrangement provides immunity to false tripping by a mass of metal and in combination with selectivity of the amplifier prevents tripping by a coil of another tuned frequency, even with considerable variation in separation distance caused by sway of the cars. This detecting system also has good immunity to stray magnetic fields such as are caused by surges and ripples in the propulsion current on electrified railroads.

The oscillator-amplifier units and the associated relays are designed as panel units arranged for quick-detachable mounting on a rack, with plug connectors for the electrical circuits. The panels are narrow so as to fit in the narrow type of signal cases commonly used in subway signaling. The rack can be suspended in the case by rubber shock mounts when required. Each oscillator-amplifier unit is mounted on a separate panel strip and each identification frequency operates independently of the others so that in case of trouble such as a tube failure, only the one identification is affected and it is very simple to locate the defective unit and restore it to service with a minimum of delay.

The equipment will respond properly for any train speed and will operate only once for a train even if it should stop exactly at the identification point. The relay circuit is arranged to restore itself automatically in a predetermined short time after passage of the train or if desired can be reset by means of a push button.

There is no appreciable radiation from the transmitting coil at the frequencies used, approximately 50 to 200 kilocycles, and consequently there is no interference with other equipment or with identification of trains on adjacent tracks. The induction field becomes negligibly small at distances from the transmitting coil more than two or three times its diameter.

Action Recommended

Acceptance as information.

ELECTRONIC CUT-OFF FOR PEDESTRIAN WARNING SIGNAL

One of the Eastern roads with heavy commuter traffic provided warning at pedestrian crossings at stations where passengers cross main tracks to the opposite platform, by the installation of vertically mounted flashing light units attached to the intertrack fence at the gate for the pedestrian crossing. The flashing light units are operative for the approach of a train and inoperative when the rear end of the train has passed the pedestrian crossing. Where existing track circuits were properly located they were used; however, where they were not properly located an electronic cut-off was developed to offset the necessity for further cutting the track circuits, the cost of which is prohibitive in electrified territory when a warning of this type is being considered.

The electronic cut-off, which is superimposed on the existing alternating current track circuit, requires the track circuit potential to be applied at the entering end of the circuit. Sensitivity (detection of a small potential at the cut-off point in the track) is obtained by the use of a four-electrode thyatron of the indirectly heated cathode type designed for relay applications (Type 2D21), having two terminals for the series shield grid connection. The operation of the device is as follows:

Referring to Fig. 1, when a shunt is applied to the rails at the entering end of the track circuit the track relay, or its repeater, releases and applies a potential to the input winding of transformer T1 and also closes the circuit from the rails to the input winding of grid transformer T2. However, due to the train shunt there is zero voltage across the input of transformer T2 and the thyatron tube does not conduct. After the rear wheels of the last car have passed the point where the grid transformer T2 is connected to the rails a potential obtains across the input winding of the transformer T2 which is stepped up and applied to the control grid of the thyatron to initiate conduction. While the tube is conducting, the cut-off relay is energized by a current from minus 150-volt secondary of transformer T1, through shield grid 7-5, terminal A of potentiometer R6, resistor R5, to cathode-anode of thyatron, through winding of cut-off relay and resistor R1 to plus 150-volt terminal of transformer T1. Since the tube does not conduct during the negative half cycle, release of the cut-off relay is retarded by condenser C1 and resistor R2. The relay, being in series with the shield grid, will not operate if the shield grid opens. When the train shunt is entirely removed from the track circuit the track relay picks up and the device is de-energized.

Adjustment is made by using the potentiometer R6 to adjust the shield grid potential; resistor R5 provides for a minimum negative bias. Resistor R4 is provided to obtain the desired grid voltage at the time of installation.

In this application proper phasing is accomplished by using the instantaneous polarities of the several transformer windings, the transformers all being connected to the same single-phase source, thereby avoiding too critical tube operation or the use of additional components to obtain proper phasing. Thus, in the positive half of the a.c. cycle the anode and control grid are both positive when the shield grid is negative, and in the negative half of the cycle they are both negative when the shield grid is positive.

In the period of the 2½ years that the devices have been in service, the cut-off points have not varied more than 25 feet, within the ranges of ballast resistance which have been experienced.

Action Recommended
Acceptance as information.

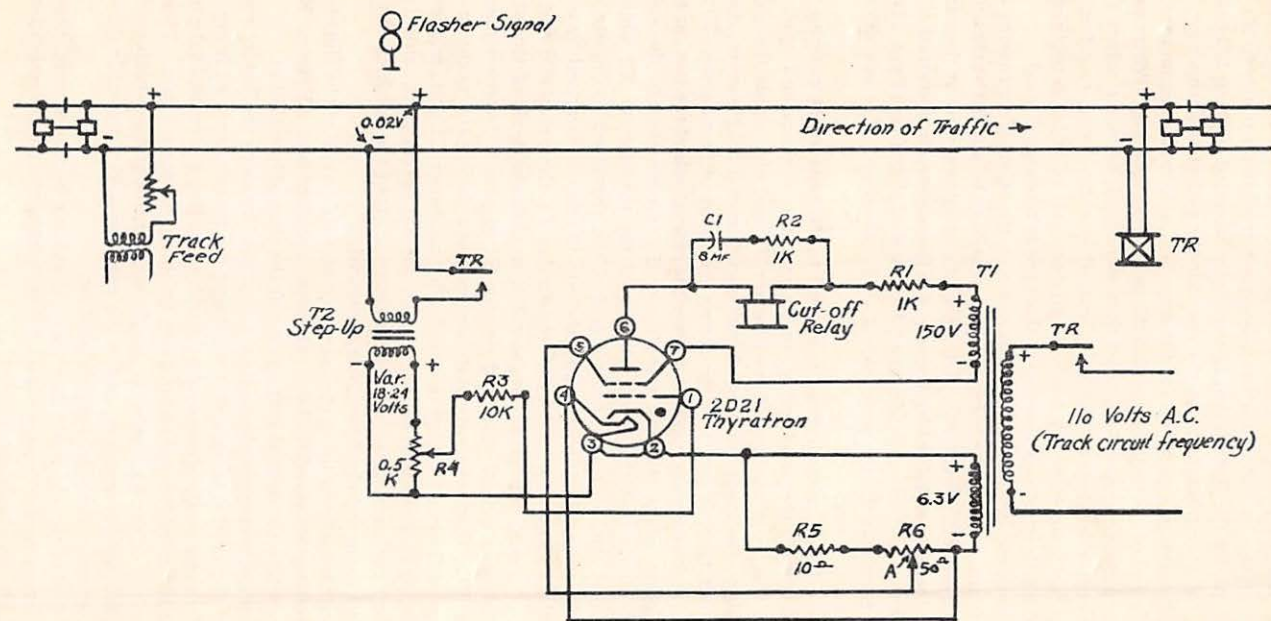


Fig. 1.
Electronic Cut-Off Circuit.

CONSIDERATIONS IN THE APPLICATION OF ELECTRONICS

Electronics is defined by the Signal Section, A.A.R., as that branch of science and technology which relates to the conduction of electricity through gases or in vacuo. Although the science of electronics has developed rapidly in recent years, it is all too often considered to be the ideal solution to the problems of signal control and transmission of intelligence. The heart of such systems is the electron tube which, when combined with the proper components of resistance, capacitance and inductance, serves to accomplish many functions not otherwise attainable. Although the electron tube has risen to a remarkable height of development wherein it is now irreplaceable in many of its functions it is still possessed of certain undesirable qualities.

Applications.

In considering the application of electron tubes for use in signal apparatus, certain advantages and disadvantages in their use should be recognized. Electronic techniques offer high versatility, accuracy, extremely high speed and efficiency. Electronic controls are easily obtainable, having sensitivities far greater than other means of control. Electronic means are especially useful for amplifying weak signals, responding to signals of too short duration for relays, performing highly repetitive relaying and power switching operations beyond the mechanical life of relays and contactors, and responding to optical conditions.

The attributes of electronic systems may be set forth as follows:

Speed of response is high.

Unlimited number of gradation steps of control are available.

Systems can be remotely controlled over great distance.

Time, force, displacement, and positional information can be converted readily to signal variations and vice versa.

Centralization of complex controls and indications can often be achieved more economically than by other means.

Special functions may be performed, such as addition, multiplication, or subtraction with different weighting factors for each variable if desired.

Electron tubes will respond at lower energy levels than other devices used to perform control functions.

Current may be controlled without opening or closing the circuit.

Coupled with the advantages of electronic systems are certain distinct disadvantages which may be outlined as follows:

The electron tube, upon which the functioning of the system depends, has shorter life and generally is far less reliable than its associated components.

Specially skilled maintenance personnel are required.

Specific problems.

In arriving at a decision on any control system the factors of performance, reliability and costs of installation and maintenance must be carefully weighed; each bearing its proper relation to the result desired. Such planning cannot be

limited to the controls only, it must also be extended to the problem from a system point of view. In considering applications in railway signaling where human life, valuable tonnage, and costly equipment must be fully protected, reliability becomes of paramount importance. It is here that the electron tube, while possessing many very desirable characteristics, must be viewed with distinct criticism for its failure to have matured as a reliable component. All other elements of the electronic system, the capacitors, resistors, inductances and transformers, are generally more dependable than the very heart of the system—the electron tube. Many factors contribute to the deficiency of the electron tube. Principal of these are faults of the cathode or electron emitter, the vacuum tightness, the gas content, grid emission, and mechanical design.

Cathodes.

Every tube has a cathode of some kind whose duty is to emit electrons and many premature tube failures are caused by cathode failure. Except for pure metal filaments, most cathodes are complicated composite materials, such as oxide coatings deposited on metal cores; or they can be some form of metal impregnated with other materials, as, for example, thoriated tungsten. Their operation depends on a fine balance between diffusing a sufficient amount of emissive material to the surface as opposed to evaporating too much of the emissive material. Cathodes are sensitive to contamination by minute impurities, which can come from elements of the tube, from the glass or from chemicals that have been used to clean tube parts. These composite cathodes must be operated near their rated temperatures in order to obtain satisfactory operation.

Vacuum tightness.

All electron tubes must be essentially vacuum tight in order to continue operation. In the manufacturing of tubes many are rejected at inspection because the vacuum is not sufficiently perfect. Undoubtedly a certain number of tubes are shipped that leak so slowly as to defy detection. Those tubes that are called "vacuum-tight" simply leak so slowly that they may last for many years without becoming too gassy to function properly.

Gas content.

In electron tubes, two actions occur: namely, the gradual evolution of gas from certain metal parts due to temperature and electron bombardment, and the gradual absorption or clean-up of gas by other surfaces in the tube.

In the high-vacuum type of tube, it is fortunate that this gas clean-up action exists. Without it, large high-vacuum power tubes might not be practical. Here, the satisfactory maintenance of high vacuum depends in part upon the action of gas clean-up by certain electrodes keeping pace with the gas evolution from other electrodes. Fortunately, in this case there cannot be too much gas clean-up, since the better the vacuum the better the condition. Failure from this cause results only when gas evolution exceeds gas clean-up. In gas-filled thyatron, which depend upon the maintenance of a specific gas pressure throughout their operating life, this balance is more delicate and even with the best known techniques, gas clean-up eventually develops too low a gas pressure for satisfactory operation and the tube ceases to function.

Sept. 1952]

Grid emission.

Many tubes, such as triodes, tetrodes, and thyatrons, have grids that control the current between cathode and anode. For the control characteristics of the tube to remain constant, the primary emission (due to temperature), the secondary emission (due to electron bombardment), and the current collected or intercepted by the grid must all remain constant throughout the life of the tube. Both the primary and secondary emissions are sensitive to minute traces of impurities deposited on the grid metal. Since cathodes invariably vaporize a certain amount of active material, a grid material must be used that remains constant in its characteristics regardless of contaminations.

Mechanical design.

In the manufacture of electron tubes, as in radio receivers for example, many connections or joints must be made by either welding, soldering, brazing, riveting or clamping. If a connection fails in a receiver it can be repaired. If it happens within a tube it cannot be repaired and the tube must be scrapped. Making reliable connections is complicated by the necessity of using and joining widely dissimilar materials that operate at widely differing temperatures. The choice of joining methods is further limited by the necessity of avoiding any flux or other material that will cause the tube to become gassy, or any material that will evaporate at operating temperatures causing contamination of other tube parts or leakage over insulators.

Another common factor in all tube designs is the problem of insulating the various elements of the tube from one another. These insulating sections may be glass, mica or ceramic. In most cases they form all or a part of the vacuum-tight envelope and also become a part of the mechanical support for the tube elements. Both glass and ceramic materials are brittle, will withstand only a limited thermal shock, and generally do not form a perfect union with the metals to which they must be sealed. The insulating sections should be long to improve insulation and short to improve mechanical strength. The design, therefore, is a compromise between these two requirements and is a balance between insulating reliability and mechanical ruggedness. The insulating material must be vacuum-tight, relatively free of gas content or easily out-gassed, and must have a temperature coefficient of expansion, matching as closely as possible one of the metals to which it is joined. The choice of insulating material is further limited by the fact that it must be suitable for forming vacuum-tight seals.

The function of an electron tube is vitally dependent upon the geometry of the element structure. Spacings of grid wires frequently must be held to tolerances of the order of plus or minus 0.0005 inch. It is necessary that precise dimensions be maintained when the tube is subjected to long periods of vibration, and mechanical and thermal shock.

These are the principal factors contributing to the reliability or unreliability of electron tubes. Intensive research and engineering development will be required to bring about their satisfactory improvement.

Reliability in electronics.

Probably electron tubes depend for their operation on a greater number of little understood factors than any other product in mass production. Tube manufacturers and industrial users, being cognizant of this fact, have under-

taken extensive development programs directed at ruggedizing and refining electron tubes for industrial application.

The commercial airlines, faced with operating conditions very similar to those of the railroads, have initiated a thorough redesign of the tubes they require. Actual development work is being performed by several tube manufacturers and coordinated by Aeronautical Radio Incorporated, the airlines communications agency. The miniature tubes are very well suited to the airlines requirements of weight and space and a program for the development of reliable long-life types of miniature tubes was instituted for ten tubes.

The types of ruggedized long-life and the original versions are as follows:

Tube	Ruggedized	Type Number	Prototype
Pentode.....	5654		6AK5W
Twin Triode.....	5670		2C51
Double Diode.....	5726		6AL5
Pentode.....	5725		6AS6
Pentode.....	5749		6BA6
Pentode.....	5686		None (new tube)
Hi-Mu Twin Triode.....	5751 (Z 1764)		12AX7
Pentagrid Converter.....	5750		6BE6
Medium-Mu Twin Triode.....	5814		12AU7
Thyratron.....	5727		2D21

Under this program, the airlines return to the manufacturer all defective tubes with complete service data showing hours of service, equipment in which they were used, and the function for which they were employed. The defective tubes are analyzed by the manufacturer and remedial measures are introduced in the manufacture to eliminate the cause of failure. Industry-wide savings in the first year of this reliable tube program have been estimated to be \$100,000 in tube replacement alone. Reductions in maintenance costs and mechanic's time in handling and servicing equipments and records account for an additional \$150,000, giving a total of a quarter-million dollars saved in the first year.

The National Bureau of Standards Electron Tube Laboratory is investigating all aspects of electron tube ruggedization. They are making a survey of the actual operating conditions for tubes in various kinds of commercial, industrial, and military apparatus. Test equipment is now in operation to study the effects of vibration, mechanical resonance, high-impact shock, and high-speed centrifugal forces. Tubes are examined after ruggedness tests for structural failures. X-rays are frequently employed to reveal the extent of structural changes without opening the tube envelope. Materials for certain tube elements are examined spectroscopically to determine their exact composition and to find impurities that might weaken the tube structure. From these studies come recommended specifications for materials best suited to particular applications.

Many of the electron tube manufacturers have had accelerated development programs in operation for some time, endeavoring to produce suitable ruggedized or reliable tubes. As a result, a number of redesigned tubes have been offered for commercial and military use which have proved to be of superior quality. Nevertheless, all concerned with the problem continue to give full

recognition to the need for much greater improvements than have yet been obtained before the electron tube can, in general, assume its proper place in industry.

Many field troubles with electron tubes fall in one or more of the following categories:

- The use of tubes when some other device would be more suitable.
- Failure to select the proper tube for the job.
- Failure to operate the tube at or below its ratings.
- Actual engineering errors in the design of the circuit.
- Failure to incorporate adequate protective devices in the system.

Reliability must be designed into the electronic system. In making applications in railway signaling the "fail-safe" or closed circuit principle must not be compromised and designs must be such that any conceivable tube fault results in a "safe" failure.

Tubes, of course, eventually fail and in the long run the rate of failure follows the usual probability curve. Most failures occur close to the average life expectancy but a certain percentage of failures occur before or after that time, some tubes failing quite early in life. This characteristic has been rather carefully investigated by one of the tube makers wherein the statistical evaluation of tube life expectancy has been demonstrated to show promise as a means for predicting the life of a specific run of tubes from the production line. The procedure involves a 500-hour life test on a sample lot to which statistical methods are then applied to predict the life curve of the entire run. Further development of the procedure may offer the tube maker a means for stating conservative tube life of the reliable types. Procedures have also been developed whereby initial run-in tests can be made which reduce the number of early failures.

Probably the greatest threat to reliability in electronic equipment is the continual pressure from users and equipment designers to increase the ratings. Such a trend is completely contrary to the desire for greater reliability. The telephone systems obtain long life and maximum reliability by operating tubes below their ratings. Until better tubes are available, the same should hold for industrial apparatus.

Often, laboratory tests must be made to determine if tubes are actually being used within ratings. Another common occurrence is that two or more tubes operated in parallel do not divide the load properly, so that one tube becomes overloaded while the other is underloaded. This is especially likely to happen with gas-filled tubes, which do not operate properly in parallel unless specific means are provided in the circuit for this purpose.

Considerable benefit can be gained by operating tubes below their ratings, and by actual tests to prove that conditions in a circuit are as they appear to be. Complete tests on finished models with oscillograms to show transient conditions will also detect many design errors that would otherwise go unnoticed.

Inadequate protective devices are often a costly factor. Tubes do not, as a general rule, have the factor of safety inherent in other components, so the omission of an adequate protective device may result in the tube being destroyed or damaged when a fault occurs in the circuit.

Another frequent cause of trouble is the failure of the equipment designer to

take into account the extent to which characteristics vary from tube to tube and during the life of the tube.

Of course, all such careful and painstaking measures on the part of the tube manufacturer tend to increase the cost of a tube many times over that of the ordinary type supplied to the radio receiver market. However, by shifting a larger portion of the total effort to the manufacturer, the maintenance problem facing the industrial user is greatly reduced. Industrial worth of electronic equipment is measured in terms of its uninterrupted performance in the field. The shift of the maintenance load to the manufacturer reflects back to the field in the form of improved reliability. In general, the manufacturer is better able to cope with the problems attendant to equipment design than is the industrial user able to cope with the now unwieldy problem of maintenance and repair.

The maintenance problem.

The railroads as well as many other industries find it difficult to provide skilled maintenance personnel who can perform necessary technical procedures. The railroad plant, being largely an out-of-doors one extended over miles of open country, does not lend itself to field maintenance of delicate equipment. These factors indicate the need for definite measures to offset the deficiencies in maintenance ability. Obviously, reliability of the highest order would contribute most to this situation. Plug-in assemblies, constructed according to functional units, are a convenient way to insure minimum out-of-service time due to a failure. The concept here is for the user to effect on-the-spot replacement of the faulty subassembly by inserting pretested units in the equipment until the faulty unit is found and replaced. Although this is not a new idea it is an effective way to make repairs and eliminate the need for elaborate field maintenance service.

Until such time as inherent reliability of electron tubes can be materially improved, certain steps can be taken to provide greater reliability consistent with railway operating conditions—provide duplicate equipment for use when the primary system fails, and provide high degree of preventive maintenance.

Action Recommended

Acceptance as information.

CARRIER LEVEL METER

General description.

A carrier level meter has been developed by the Union Switch & Signal Division of the Westinghouse Air Brake Co., to facilitate the installation and maintenance of coded carrier control systems. As these installations usually have other communication facilities superimposed on the same line circuit, the requirements were for a simple portable type instrument which could be used to measure the coded carrier frequencies without disturbing operation of the system and which would be free of interference with signals of other frequencies appearing on the line.

The instrument functions on impulses of carrier so that voltages can be checked quickly and accurately while codes are in progress. This feature is particularly advantageous in that operating margins for both office and field carrier units can readily be determined by measurements made at the office location, without the need for stationing men at remote carrier locations for the purpose of providing a steady signal. Characteristics of the instrument are such that its use produces no adverse effect upon system operation.

Interference from other frequencies appearing on the line is prevented through the use of filters. These filters permit the carrier level meter to be used as a frequency standard for adjusting frequency determining units and transmitting and receiving filters. The use of this meter greatly facilitates such adjustments.

For another important application, the filters can be disconnected and the meter then affords a convenient means for observing unusual phenomena appearing on the line.

The carrier level meter consists essentially of a small oscilloscope and a calibrator combined into a single compact unit assembled in a substantial case. It is designed for operation on 110 volts, 60 cycles, and can be connected to any ordinary outlet of such power. Power consumption is approximately 42 volt-amperes (at 115 volts), which is sufficiently low that the meter can be energized from a tuned alternator or other suitable a.c. source. Switches and dials on the meter are conveniently arranged to facilitate necessary manipulations. The filter is plug connected on top of the instrument case.

Filters used with the carrier level meter are the same highly selective devices regularly employed in the coded carrier control apparatus. Each filter is accurately tuned for a particular frequency. In emergencies, the meter filters can be used as spares for the coded carrier control units.

The basic principle of the carrier level meter is that of visually comparing the amplitude of the coded carrier voltage to that of a known voltage, by means of the oscilloscope. The known or calibrated voltage is supplied by the calibrator whose output is a square wave 60-cycle signal. Since the oscilloscope serves as the indicating device, the unknown voltage may be either coded carrier pulses or a steady signal. Alternate half-cycles of the square wave output of the calibrator are fed to the oscilloscope by means of the back contact of a relay which operates at the rate of 60 complete operations per second. During the other half-cycle intervals, the carrier voltage is applied to the oscilloscope over the front contact of the relay. In this manner a composite

image showing both voltages is presented on the oscilloscope screen. The height of the calibrated voltage can then be adjusted to match the height of the carrier voltage. The voltage reading appears on the dials of the calibrator.

Two optional types of dial markings are available. The more usual type reads directly in volts, while the other type is marked to show decibels.

Applications.

Principal uses of the carrier level meter have been mentioned in the foregoing. The purpose of the following description is to outline briefly the simple procedure for using the meter for several applications.

1. When the carrier level meter is used as a voltmeter, the proper filter is applied and the switches are positioned so that the filter is in the circuit and connected to the line. The relay is started and the gain of the oscilloscope adjusted so that the unknown voltage produces a pattern easily visible on the oscilloscope screen. After the calibrator is turned on, it is adjusted until the amplitude of the calibrated voltage is the same as that of the unknown voltage. The voltage (or decibel) reading appears on the calibrator dials. Where a quick reading must be made, the sweeping rate of the oscilloscope should be set at a low value so that alternate pulses of the carrier voltage and the calibrated voltage appear on the screen. The amplitude of the calibrated voltage is then adjusted to match that of the unknown voltage and the voltage reading obtained from the calibrator dial. In this instance, the 60-cycle pulses of carrier voltage will be interrupted by the centralized traffic control coding. However, experience on a number of installations has proved that this is not confusing. Where greater accuracy is desired and time is not an important factor, the sweeping rate of the oscilloscope should be so adjusted that only a part of the 60-cycle pulse appears on the screen. Under these conditions, the sweeping rate can be so adjusted that the carrier voltage appears as a sine wave curve and the calibrated voltage becomes a straight line superimposed on the sine wave curve. The straight line can then be accurately adjusted to match the tops of the sine wave curve.

2. In using the carrier level meter as a frequency standard for adjusting frequency determining units or transmitting filters the manipulations are essentially the same as when used as a voltmeter. However, when the calibrated voltage is nearly equal to the unknown voltage, the frequency determining unit or the transmitting filter is adjusted to produce maximum possible voltage reading on the meter. During this procedure the oscillator being adjusted is not varied except as may be necessary to bring the image on the oscilloscope screen or to meet other requirements as to voltage levels. For ease in determining when the voltage is a maximum, the calibrating voltage line should be kept near the same height as the unknown voltage. For this kind of adjustment, the meter may be connected to the line anywhere the unknown signal appears. The most natural place, of course, is across the output terminals of the oscillator being adjusted.

3. Practically the same manipulation applies when the meter is used as a frequency standard for checking the adjustment of receiving filters. When the desired frequency determining unit has been adjusted to agree with the standard filter on the meter, the receiving filter to be checked is applied to the meter and the core of the receiving filter adjusted to produce the maximum possible reading on the meter. It should be noted, however, that adjustment of re-

ceiving filters should be made only when there is a definite reason to believe the filter is not functioning properly, and then only by a qualified person. In emergencies, the meter filter may be used in place of the regular receiving filter for any particular frequency

4. When making adjustments prior to placing a coded carrier control installation in service, the carrier level meter is used both as a voltmeter and as a standard of frequency, as necessary. In this application, the calibrated filters used with the meter are considered to be the frequency standards, instead of the receiving filters which are applied to the oscillator-amplifier units. Usual pre-installation adjustments for which the carrier level meter is particularly suited are as follows:

(a) For adjusting frequency determining units as outlined in paragraph 2.

(b) For checking maximum output of oscillator-amplifier units.

(c) For checking sensitivity of all receivers, using the newly adjusted frequency determining units for supplying the required potentials. On any receivers which do not meet specified limits, the tuning of the receiving filters can be checked as mentioned in paragraph 3.

(d) For setting carrier levels, using the carrier level meter as a voltmeter since the readings may be filed for future reference.

(e) For determining the operating margins of the stand-by units. This is done by reducing the transmitting level until failure occurs and measuring the output voltage at this level. The working margin is the ratio of the voltage before reduction and the voltage at which failure occurs.

5. For maintenance tests after an installation is in service, the meter is normally used as a voltmeter but in cases of trouble it may be particularly useful as a frequency standard. Typical maintenance procedures for which the meter is especially convenient are:

(a) For making periodic checks of the operating margins on the normal units for control codes. To do this, the output of each oscillator at the office is measured one at a time, using the carrier level meter during codes so as not to disturb operation of the system. Then the output is reduced to one-third its normal value. If the system still functions, the units are still in satisfactory operating condition.

(b) For making periodic checks of the operating margins of the normal units for indication codes. This is accomplished by measuring, one at a time, the received voltage for each channel. Use of the carrier level meter permits making these measurements during codes, without disturbing operation of the system and without having someone at the remote carrier location to provide a steady signal. After these measurements are made, the voltage supplied to the receiving filter is then reduced to one-third the above value by connecting a variable resistor between the line terminals and the receiving filter. If the system still functions, the original 3 to 1 operating margin still exists.

Action Recommended

Acceptance as information.

LINE FAULT-FINDERS

An application of electronics involving the use of a cathode ray oscilloscope for locating faults and errors throughout the ordinary lengths of open or cabled wire circuits by visual comparison of the variation of the characteristic impedance is described on pages 193 to 198 of the 1948 Proceedings of the Communications Section, A.A.R. Three devices are described, known respectively as the "Lookator," the "Telemetroscope," and the "Fault-Finder," and evidence is presented as to their usefulness in trouble shooting.

Further information covering use of this type of equipment appears on pages 230 to 233 of the 1949 Proceedings and on page 474 of the 1950 Proceedings of the Communications Section, A.A.R.

Action Recommended

Acceptance as information.

COOPERATIVE REPORT

COMMUNICATIONS SECTION, A.A.R.
COMMITTEE 4—RADIO AND ALLIED COMMUNICATIONS

J. I. Kirsch, Representative

Communications Section, A.A.R., Committee 4—Radio and Allied Communications in their meetings during 1951 covered the following items of interest:

1. Investigated the technical feasibility of using ultra high frequency or microwaves. In order to make this type of installation economical, it is necessary to have a need for 10 to 20 telephone channels, together with any control circuits such as centralized traffic control, teletype, etc. At this particular time, it does not appear economically feasible to use microwaves for local operation.

2. Investigated a small portable carrier type battery-operated telephone set for use of railroad maintenance forces. This instrument may find some use in the signal departments of various railroads, conducting I.C.C. tests and placing new signal installations in service.

3. Reported on pulse techniques for measuring vacuum tube characteristics. This may find some application in signal work in testing tubes for carrier and train control equipment.

4. Reported on vacuum tube testing and found that, while systematic tests can do much to prevent tube failures caused by variations of electrical characteristics beyond tolerable limits, the same procedure is not very effective in reducing the inoperable failures, that is, failures due to mechanical defects within the tube itself. It was found that the rate of inoperable failures is highest during the first 100 hours of life and should decrease rapidly thereafter. The Committee is still handling with the tube manufacturers with the view of producing more types of ruggedized tubes.

Action Recommended

Acceptance as information.

COMMITTEE XII—CIRCUIT DESIGN

Personnel

H. A. Scott, Chairman

T. L. Carlson, Vice-Chairman

S. R. Bernard	H. L. Kruke
R. A. Bishop	E. Pitt
B. E. Brooksby	L. B. Sinclair
W. H. Claus	D. H. Steiner
B. R. Dellinger	C. L. Steinmetz
O. C. French	R. E. Testerman
A. N. Goodson	M. R. Williams
H. A. Haines	F. Youngwerth
H. L. Hinton	J. E. McMahon*
E. W. Horning	R. F. Wells*

Signal Section, A.A.R.:

The following outline of work has been assigned:

1. Indexing signal literature.
2. Prepare typical circuits representing current practice for railway signaling, as follows:
 - (a) Automatic block signals.
 1. For track equipped for operation in one direction only.
 - (a) Color light type signals, conventional d.c. track circuits.
 - (b) Searchlight type signals, conventional d.c. track circuits.
 - (c) Coded track circuits with and without use of line wires.
 - (d) Electric switch locking.
 - (e) Spring switch protection.
 - (f) Approach and advance lighting.
 - (g) Light out protection.
 2. For track equipped for operation in both directions.
 - (a) Color light type signals, conventional d.c. track circuits.
 - (b) Searchlight type signals, conventional d.c. track circuits.
 - (c) Coded track circuits.
 - (d) Electric switch locking.
 - (e) Spring switch protection.
 - (f) Approach and advance lighting.
 - (g) Light out protection.
 - (b) Interlocking.
 1. Relay type interlocking, unit and route types.
 - (a) Route-check network (lever-agreement relays).
 - (b) Signal control network.
 1. Color light type signals.
 2. Searchlight type signals.
 - (c) Signal indication.
 - (d) Time locking.

* Consulting Member,

- (b) Interlocking.—Continued.
 - (e) Approach locking.
 - (f) Route locking.
 - (g) Switch locking.
 - (h) Switch control.
 - (i) Switch indication.
 - (j) Power distribution.
 - (k) Model board indications.
 - (l) Remote control circuits.
 - (m) Electric locking of hand-operated switches within interlocking limits.
 - (n) Traffic locking.
 - (o) Movable bridge protection.
- 2. Automatic interlocking.
- (c) Highway crossing signal protection.
 - 1. Control arrangement.
 - (a) Selective speed controls.
 - 2. Types of protection.
 - (a) Flashing lights.
 - (b) Automatic and semi-automatic gates.
- (d) Wayside typical circuits for train stop, train control, and cab signals.
 - 1. Continuous.
 - 2. Intermittent.
- (e) Classification yard signal systems.
 - 1. Hump, repeater, trimmer and switch signal circuits.
 - (a) Color light.
 - (b) Searchlight.
 - 2. Switch control circuits.
 - (a) Electro-pneumatic.
 - (b) Electric.
 - 3. Retarder circuits.
 - (a) Electro-pneumatic.
 - (b) Electric.
 - 4. Special circuits.
- (f) Miscellaneous.
 - 1. Power and color light train order signals.
 - 2. Lightning protection.
 - 3. OSing devices.
 - 4. Control and indication circuits using electronic devices.
- 3. Prepare compilation of principles of basic current design.

The Committee submits for consideration, reports on the following subjects*:

- 2. A.A.R. Sig. Sec. 8059A, 8063A, 8064A, 8065A, 8066A, 8067A, 8068A, 8069A and 8070A.

* Suggestions or criticisms should be submitted in writing to the Chairman of the Committee on or before September 1, 1952.

TYPICAL CIRCUITS REPRESENTING CURRENT PRACTICE
FOR RAILWAY SIGNALING*

The Committee presents 11 typical plans in progressing its assignments. These plans cover traffic control circuits utilizing normally de-energized coded track circuits, circuits for control and indication of a signal function using coded carrier frequency, traffic control circuits between attended and remote controlled interlockings, traffic control circuits using direct current track circuits and two wire line control, circuits for signaling at a spring switch, a typical circuit for coded OSing device, and circuits for automatic interlocking.

These plans represent current practice on one or more Member Roads. The plans are not to be considered as working drawings; rather, it should be understood that these are typical plans only and in their application to a specific signal situation full consideration must be given as to the type of equipment to be employed and the local conditions governing.

The plans presented are:

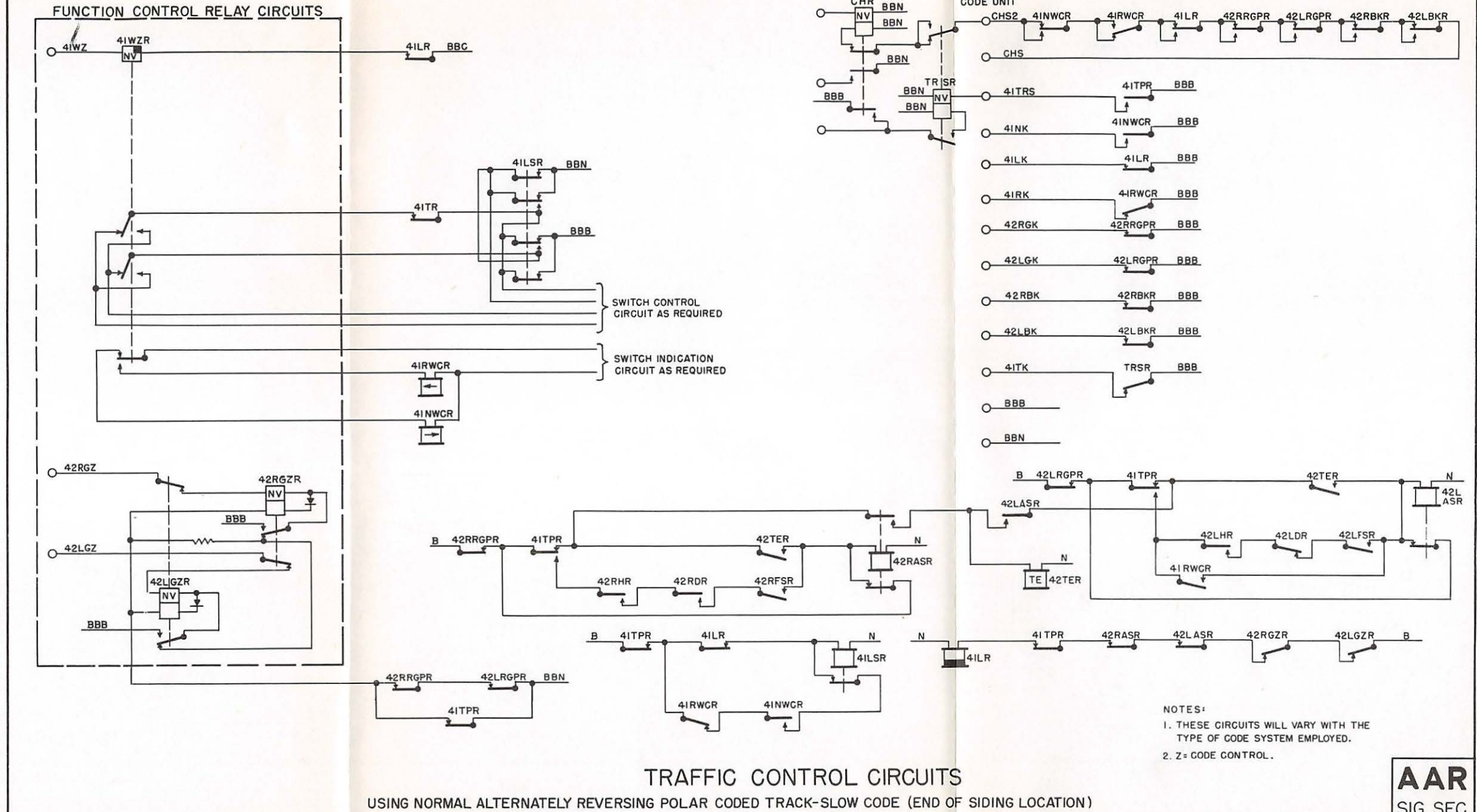
A.A.R. SIG. SEC.

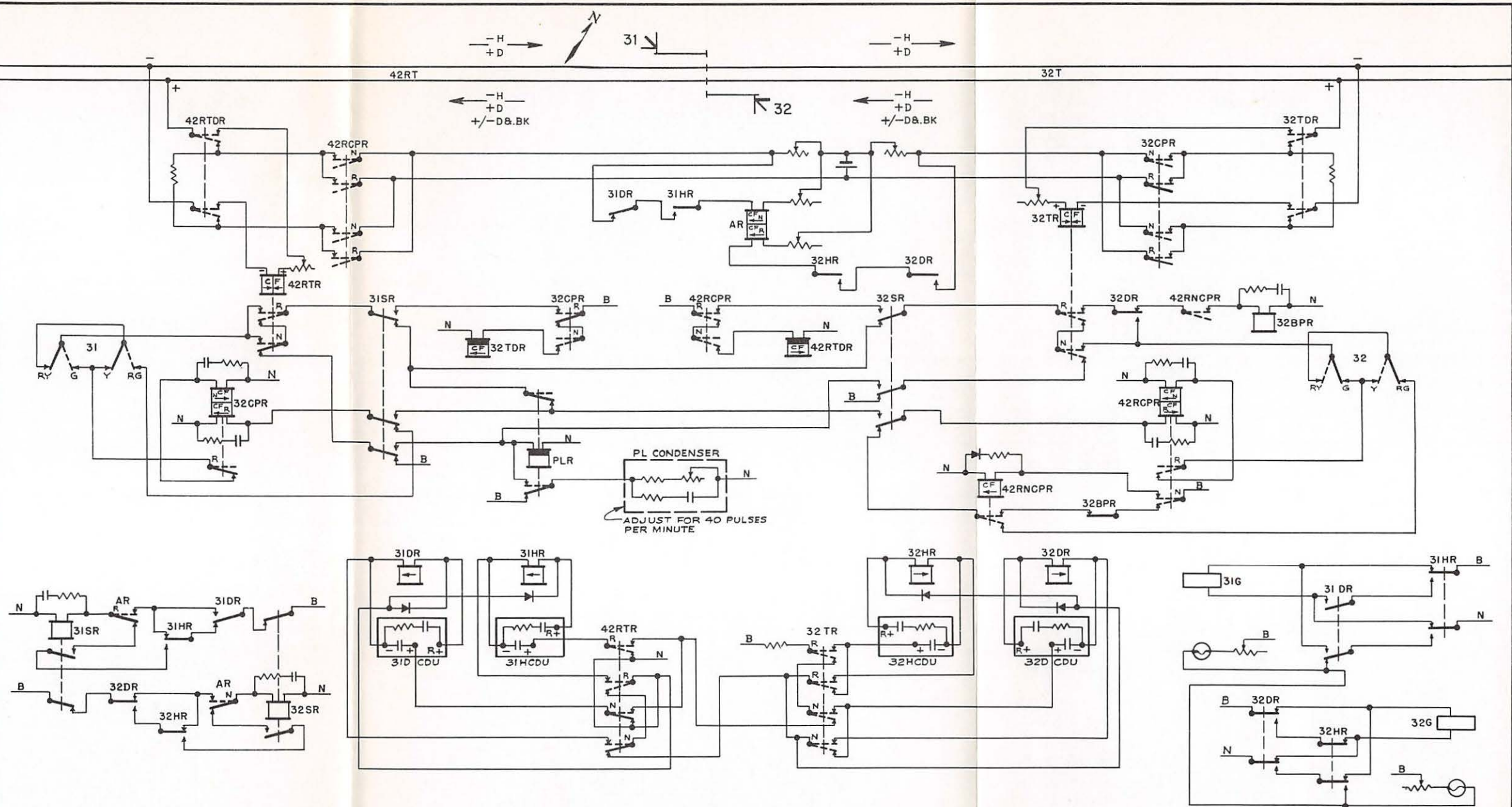
- 8059A—(Sheets 3 and 4)—Typical normally de-energized coded track circuits and traffic control without line wires. Sheet 3 covers staggered intermediate signal location and Sheet 4 covers coded line circuits for by-passing non-coded track circuits (Fig. 1) and relayed cut-section (Fig. 2). (Assignment 2-a-2-c)
- 8063A—Typical circuits for control and indication of a remote block signal, using coded carrier frequency over existing telephone line. (Assignment 2-f-4)
- 8064A—Typical traffic control circuits between attended and direct wire remote controlled interlockings—mechanical locking at attended location—circuit locking at remote location. (Assignment 2-b-1-n)
- 8065A—Typical traffic control circuits between attended and coded remote controlled interlockings—mechanical locking at attended location—circuit locking at remote location. (Assignment 2-b-1-n)
- 8066A—(Sheets 1 and 2)—Typical traffic control circuits using 2 wire HD line control (end of siding location). (Assignment 2-b-1-1)
- 8067A—Typical circuits for spring switch—track signaled in both directions—with manual clearing of siding signal and approach locking. (Assignment 2-a-2-e)
- 8068A—Typical circuits for spring switch—track signaled in both directions—with siding signal normally clear and approach locking. (Assignment 2-a-2-e)
- 8069A—Typical circuit for coded selective OSing device. (Assignment 2-f-4)
- 8070A—Typical circuits for automatic interlocking using route relays. (Assignment 2-b-2)

Action Recommended

Acceptance as information.

* Previous report on this subject appears in A.A.R. Signal Section 1950 Proceedings, Vol. XLVIII, pp. 348 and 411.





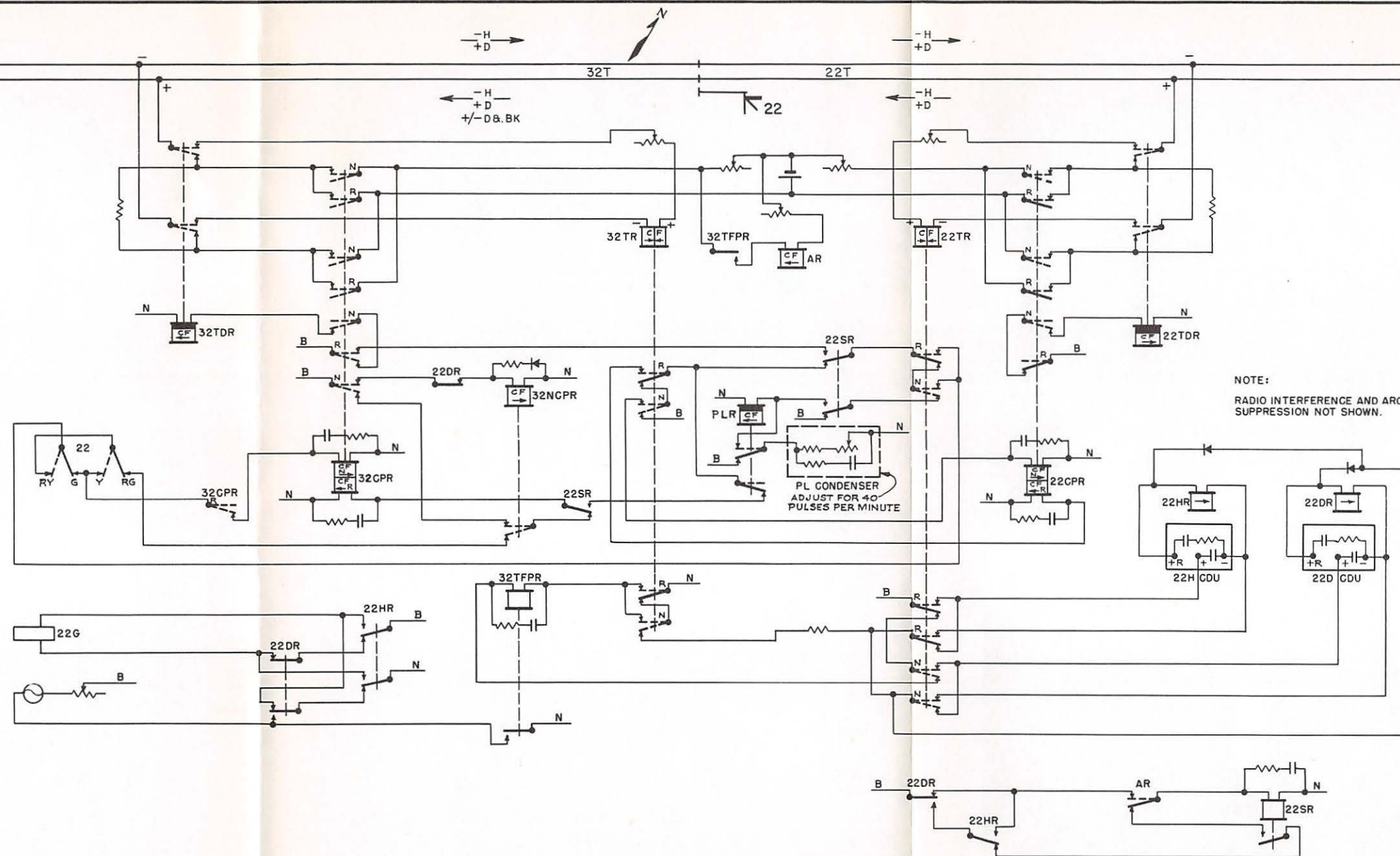
TRAFFIC CONTROL CIRCUITS

USING NORMAL ALTERNATELY REVERSING POLAR CODED TRACK-SLOW CODE (INTERMEDIATE SIGNALS OPPOSITE)

NOTE
RADIO INTERFERENCE AND ARC
SUPPRESSION DETAILS NOT SHOWN.

AAR
SIG. SEC.
8081A

SEPT. 1958



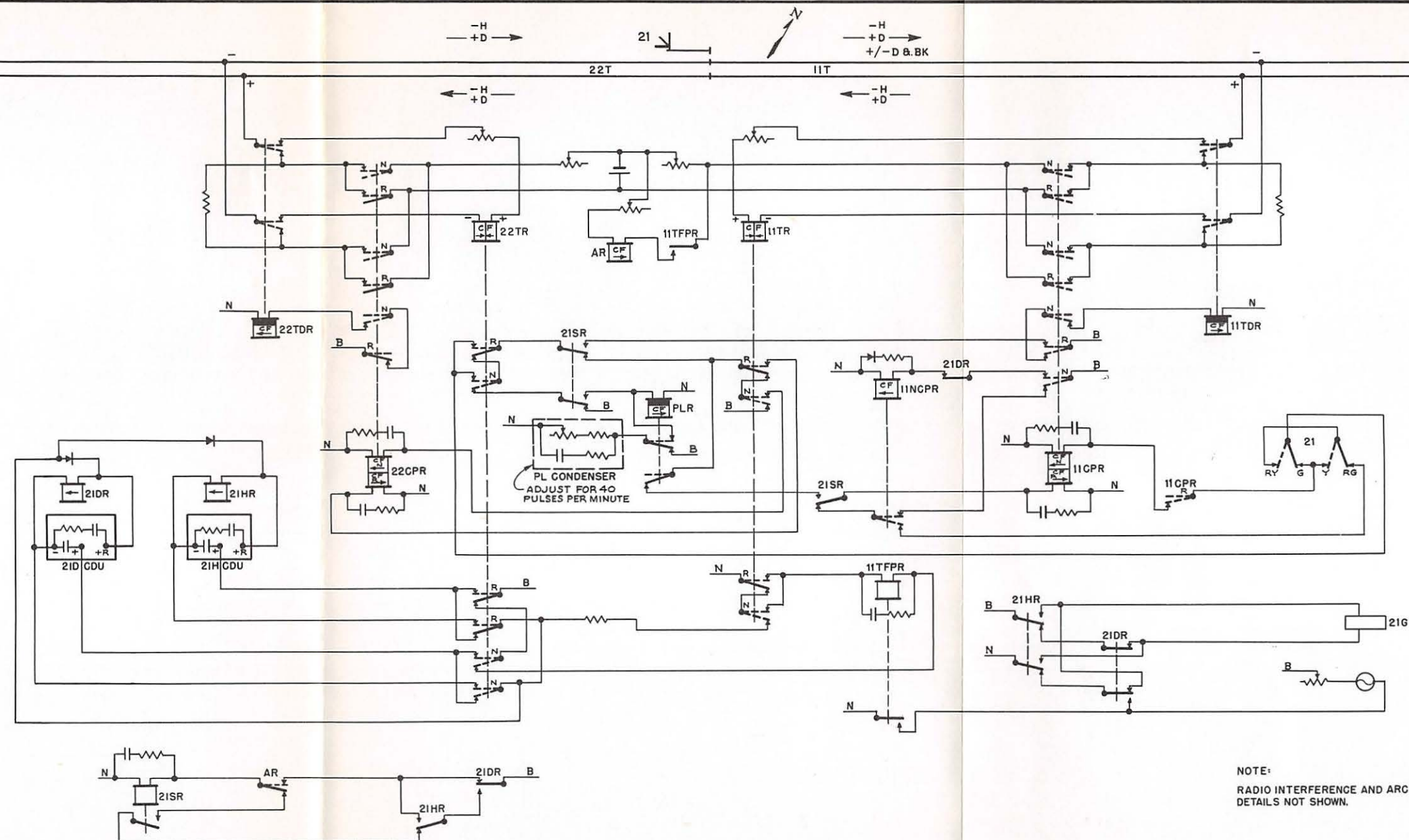
TRAFFIC CONTROL CIRCUITS

USING NORMAL ALTERNATELY REVERSING POLAR CODED TRACK-SLOW CODE (STAGGERED INTERMEDIATE SIGNAL LOCATION)

SEPT. 1958

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SIG. SEC.
8081A

SHEET 4



NOTE:
 RADIO INTERFERENCE AND ARC SUPPRESSION
 DETAILS NOT SHOWN.

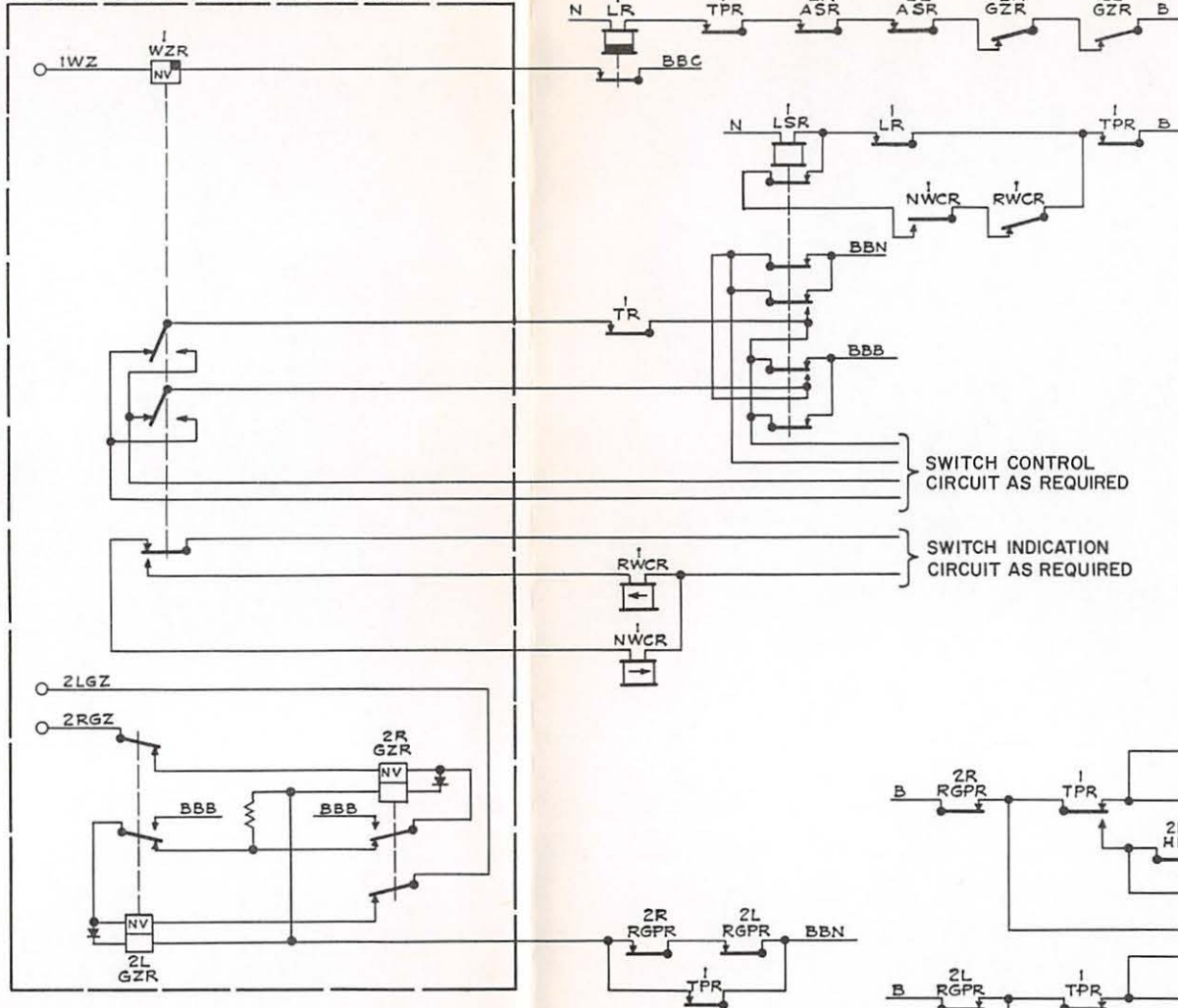
TRAFFIC CONTROL CIRCUITS
 USING NORMAL ALTERNATELY REVERSING POLAR CODED TRACK-SLOW CODE (STAGGERED INTERMEDIATE SIGNAL LOCATION)

SEPT. 1958

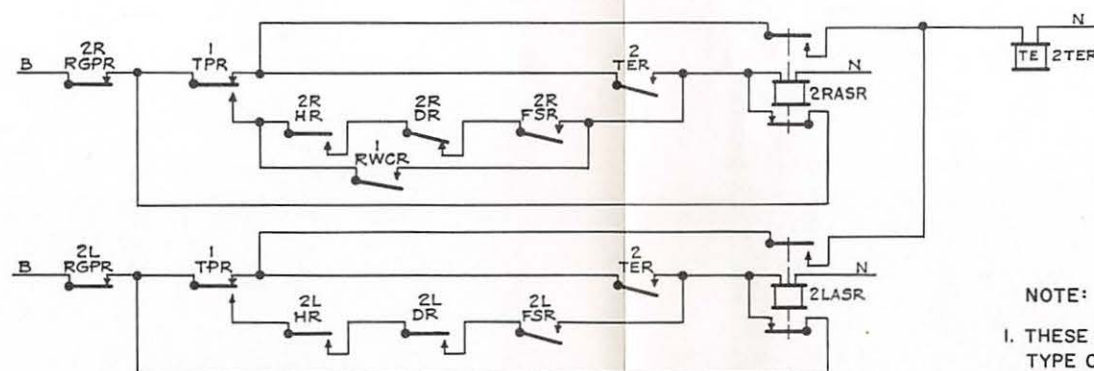
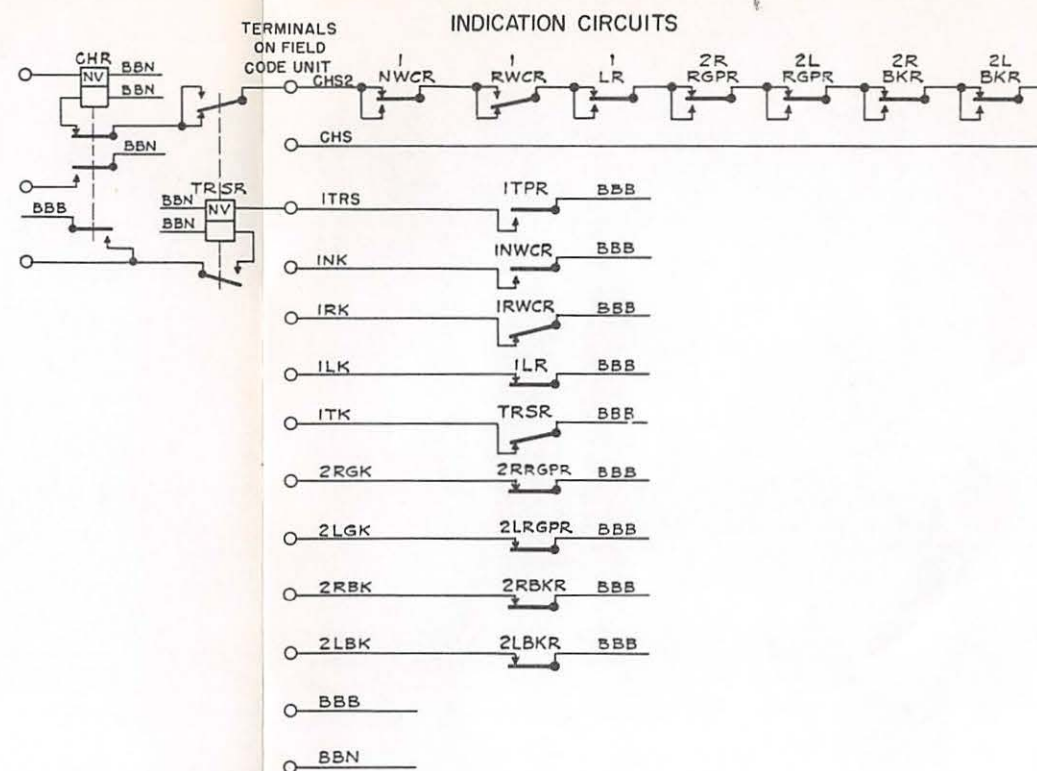
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SHEET 5

FUNCTION CONTROL RELAY CIRCUITS



INDICATION CIRCUITS



NOTE:

1. THESE CIRCUITS WILL VARY WITH THE TYPE OF CODE SYSTEM EMPLOYED.
2. Z = CODE CONTROL.

TRAFFIC CONTROL CIRCUITS

USING NORMAL ALTERNATELY REVERSING POLAR CODED TRACK-SLOW CODE (END OF SIDING LOCATION)

SEPT. 1958

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SIG. SEC.
8081A

SHEET 8

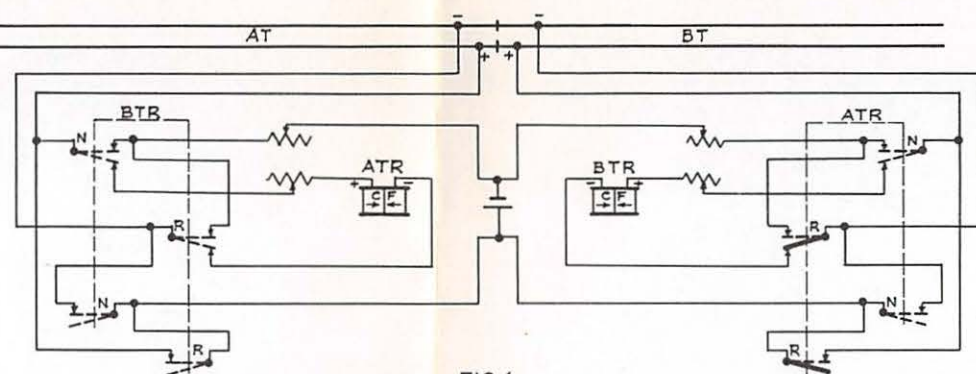


FIG. 1
RELAYED CUT SECTION

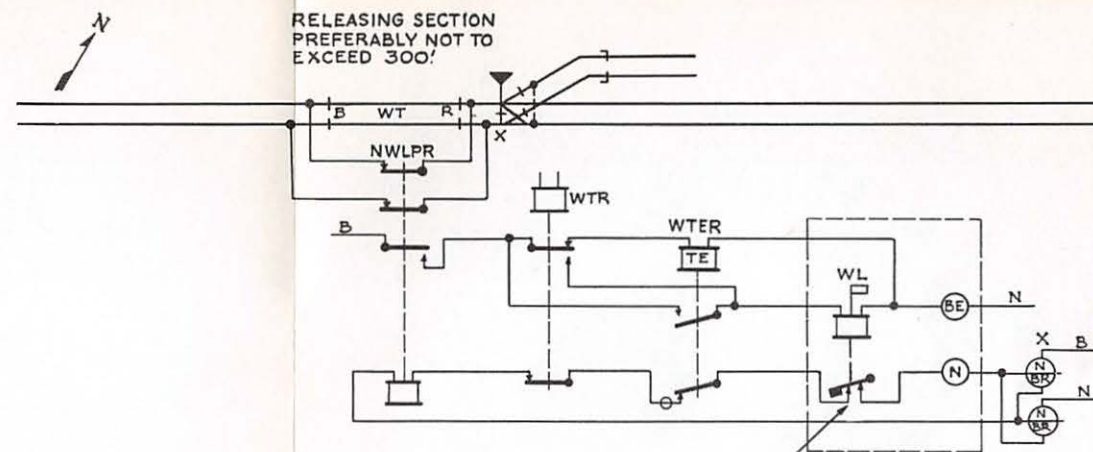


FIG. 2
ELECTRIC SWITCH LOCK

SELECTION OPTIONAL IF FORCE
DROP FEATURE IS USED.

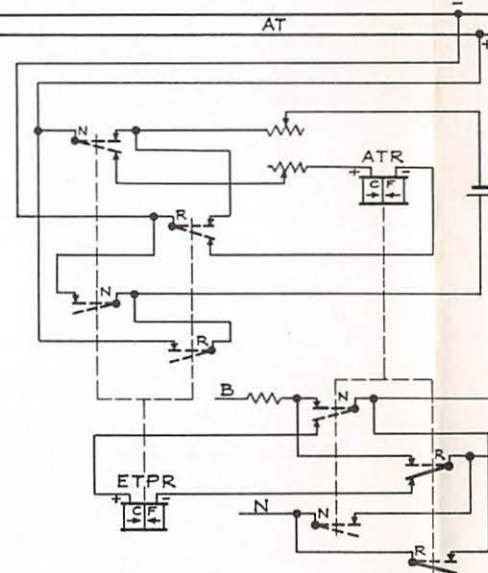
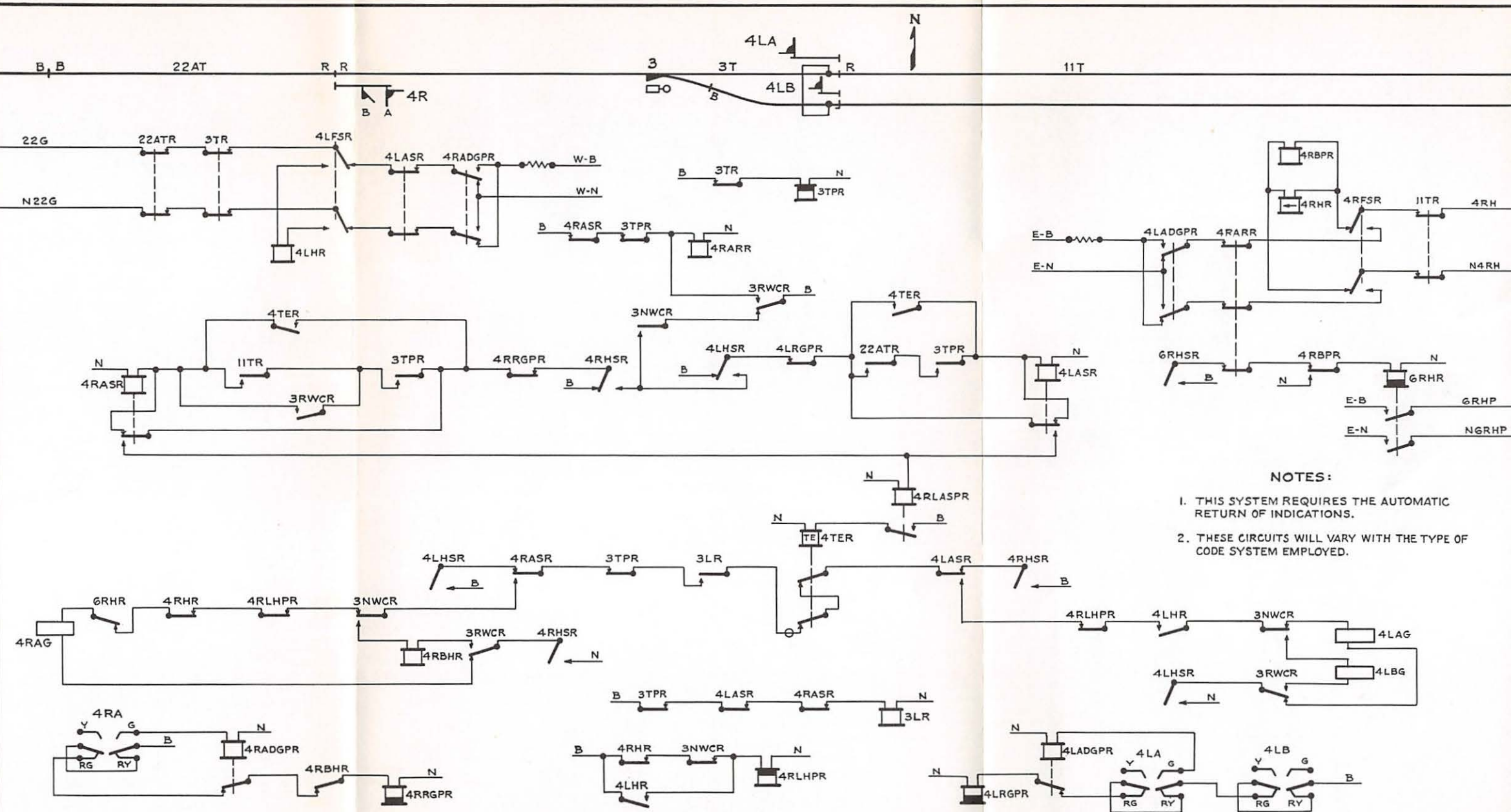


FIG. 3
CODED LINE CIRCUITS BY-PASSING NON-CODED TRACK CIRCUITS

TRAFFIC CONTROL CIRCUITS

USING NORMAL ALTERNATELY REVERSING POLAR CODED TRACK—SLOW CODE
(CUT SECTION, ELECTRIC SWITCH LOCK AND CODED LINE CIRCUITS)

NOTE:
RADIO INTERFERENCE AND ARC SUPPRESSION
DETAILS NOT SHOWN



NOTES:

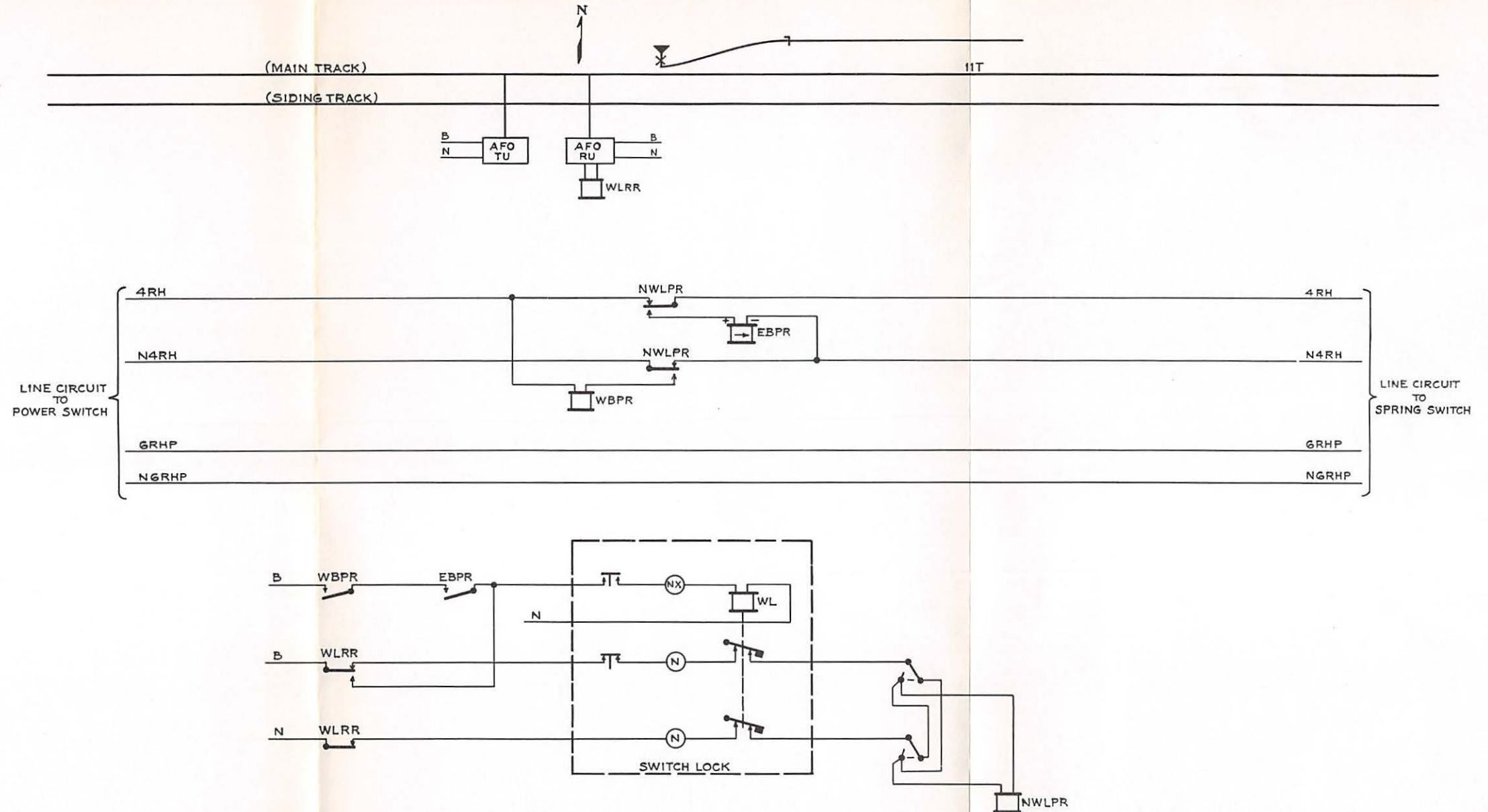
1. THIS SYSTEM REQUIRES THE AUTOMATIC RETURN OF INDICATIONS.
2. THESE CIRCUITS WILL VARY WITH THE TYPE OF CODE SYSTEM EMPLOYED.

CIRCUITS FOR MODIFIED TRAFFIC CONTROL SYSTEM
USING TWO WIRE LINE CONTROL AND SPRING-POWER ENDS OF SIDING (POWER SWITCH LOCATION)

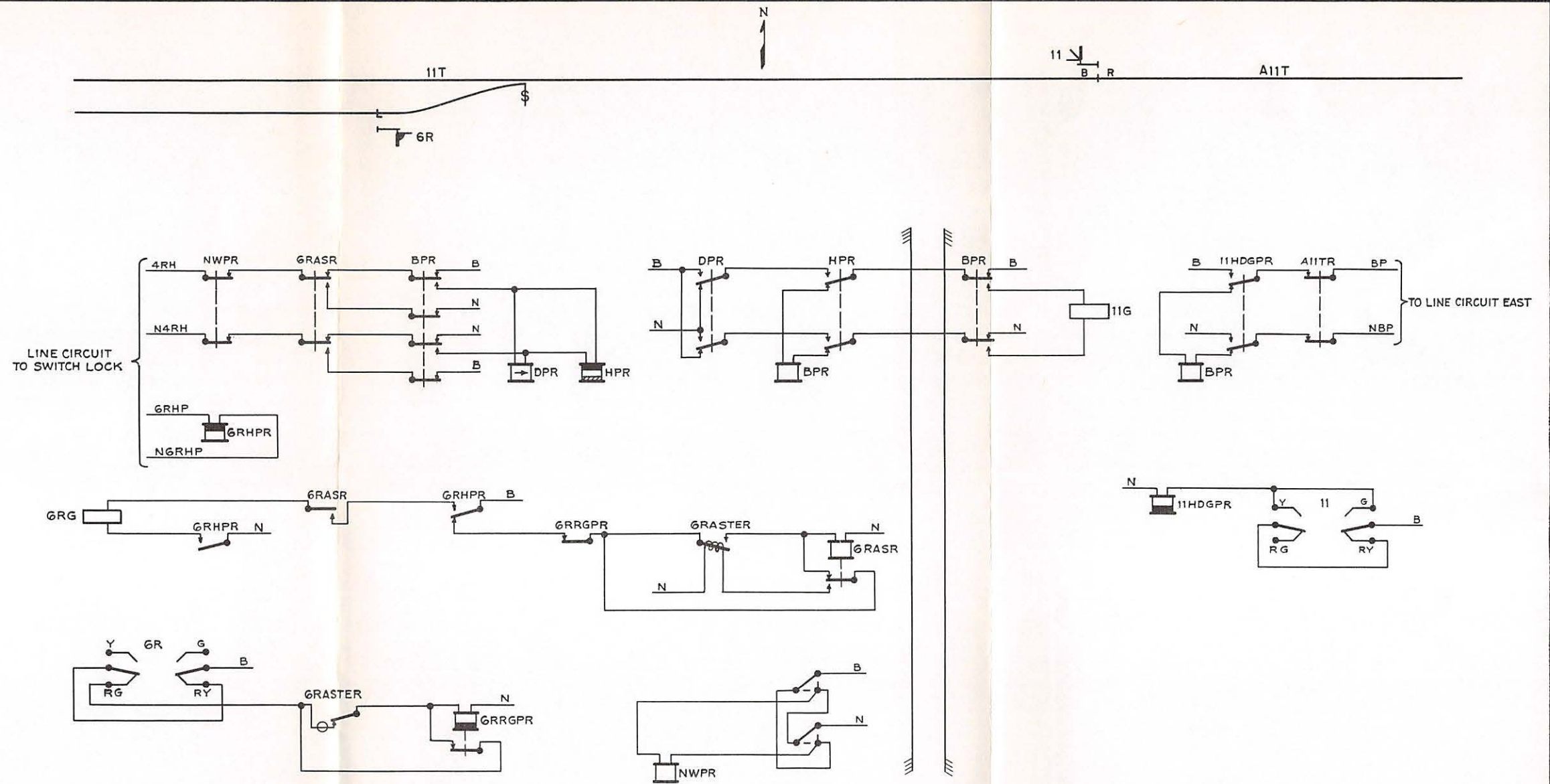
SEPT. 1958

AAR
SIG. SEC.
8082A

SHEET 1



CIRCUITS FOR MODIFIED TRAFFIC CONTROL SYSTEM
USING TWO WIRE LINE CONTROL AND SPRING-POWER ENDS OF SIDING (ELECTRIC SWITCH LOCK LOCATION WITHIN SIDING AREA)

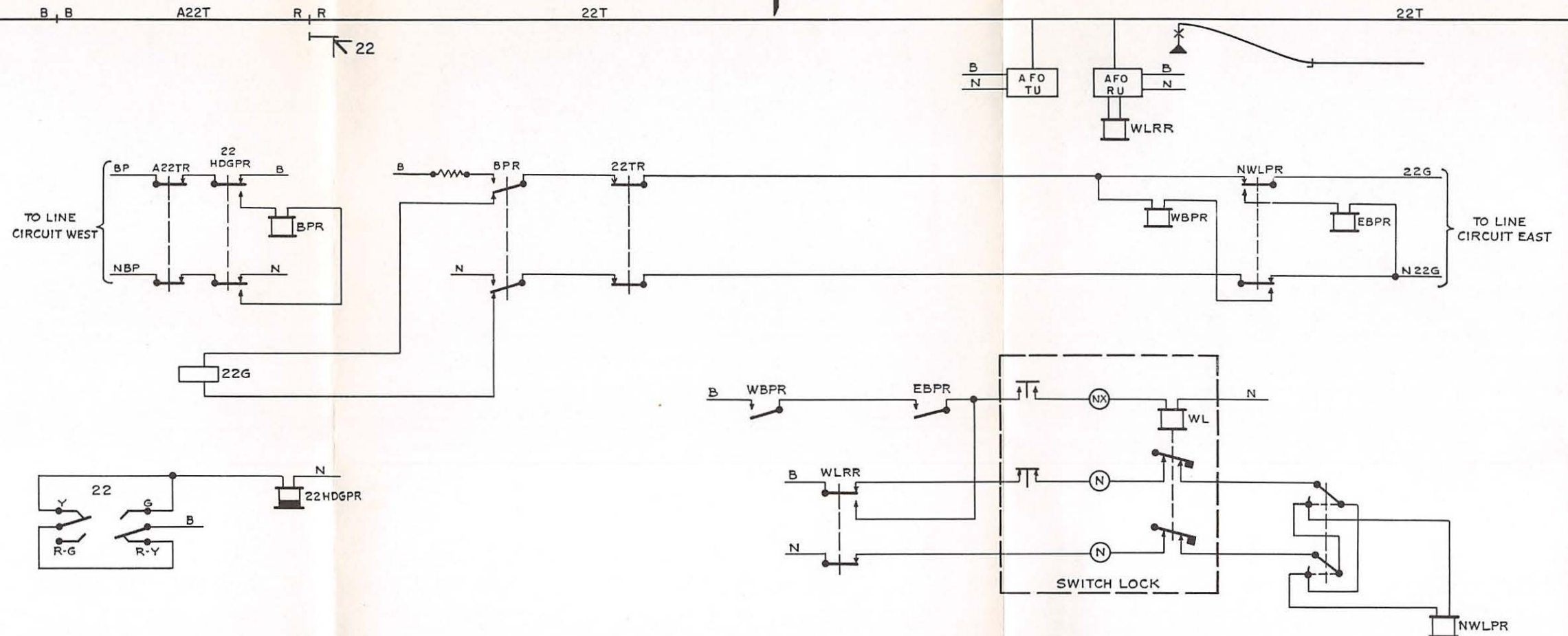


CIRCUITS FOR MODIFIED TRAFFIC CONTROL SYSTEM

USING TWO WIRE LINE CONTROL AND SPRING-POWER ENDS OF SIDING (SPRING SWITCH AND APPROACH SIGNAL TO POWER SWITCH)

SEPT. 1958

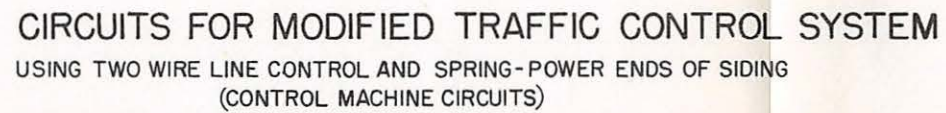
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8082A



CIRCUITS FOR MODIFIED TRAFFIC CONTROL SYSTEM
USING TWO WIRE LINE CONTROL AND SPRING-POWER ENDS OF SIDING (APPROACH SIGNAL TO POWER SWITCH AND SWITCH LOCK)

SEPT. 1958

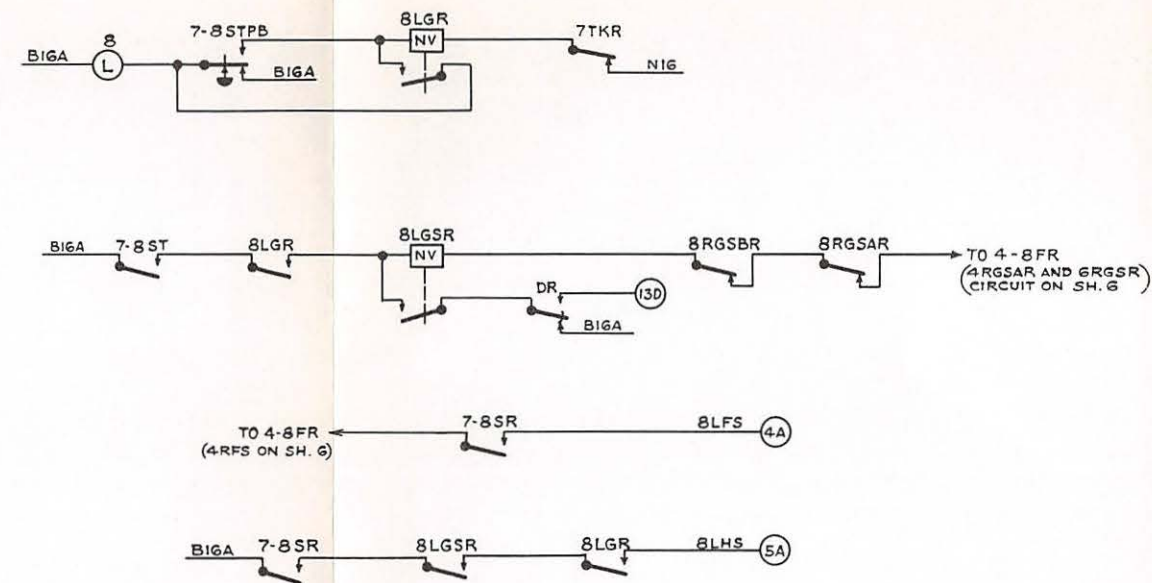
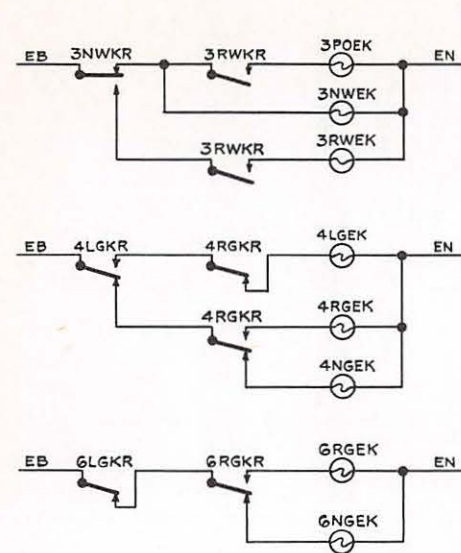
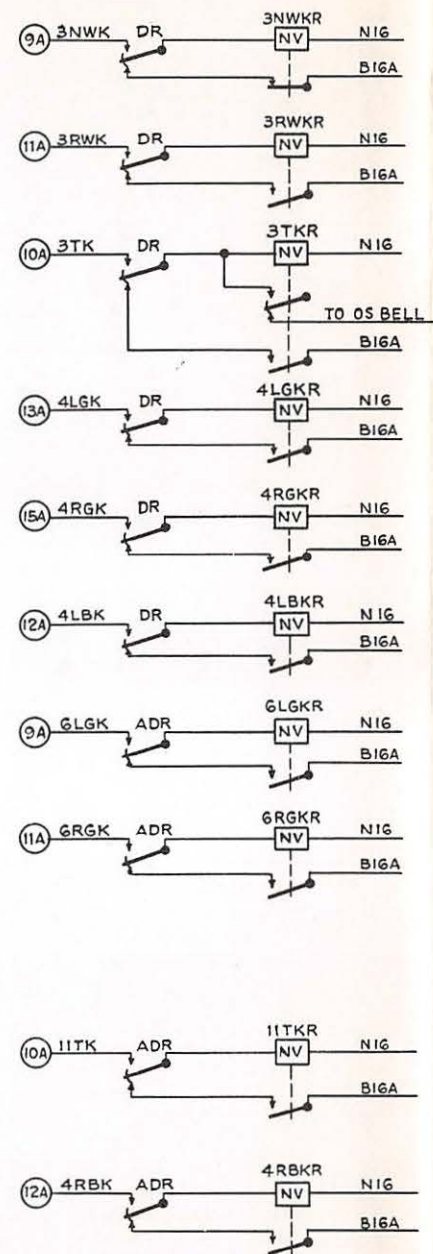
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○ — DENOTES TERMINAL ON OFFICE LINE CODING UNIT.

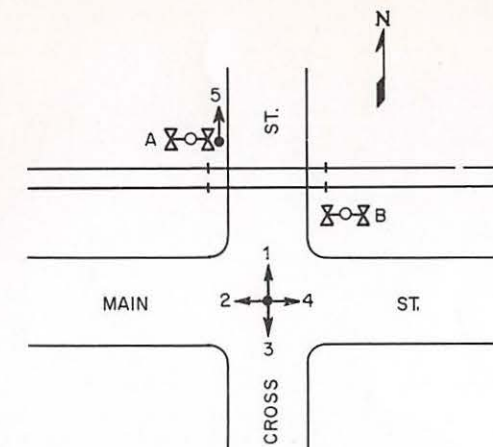
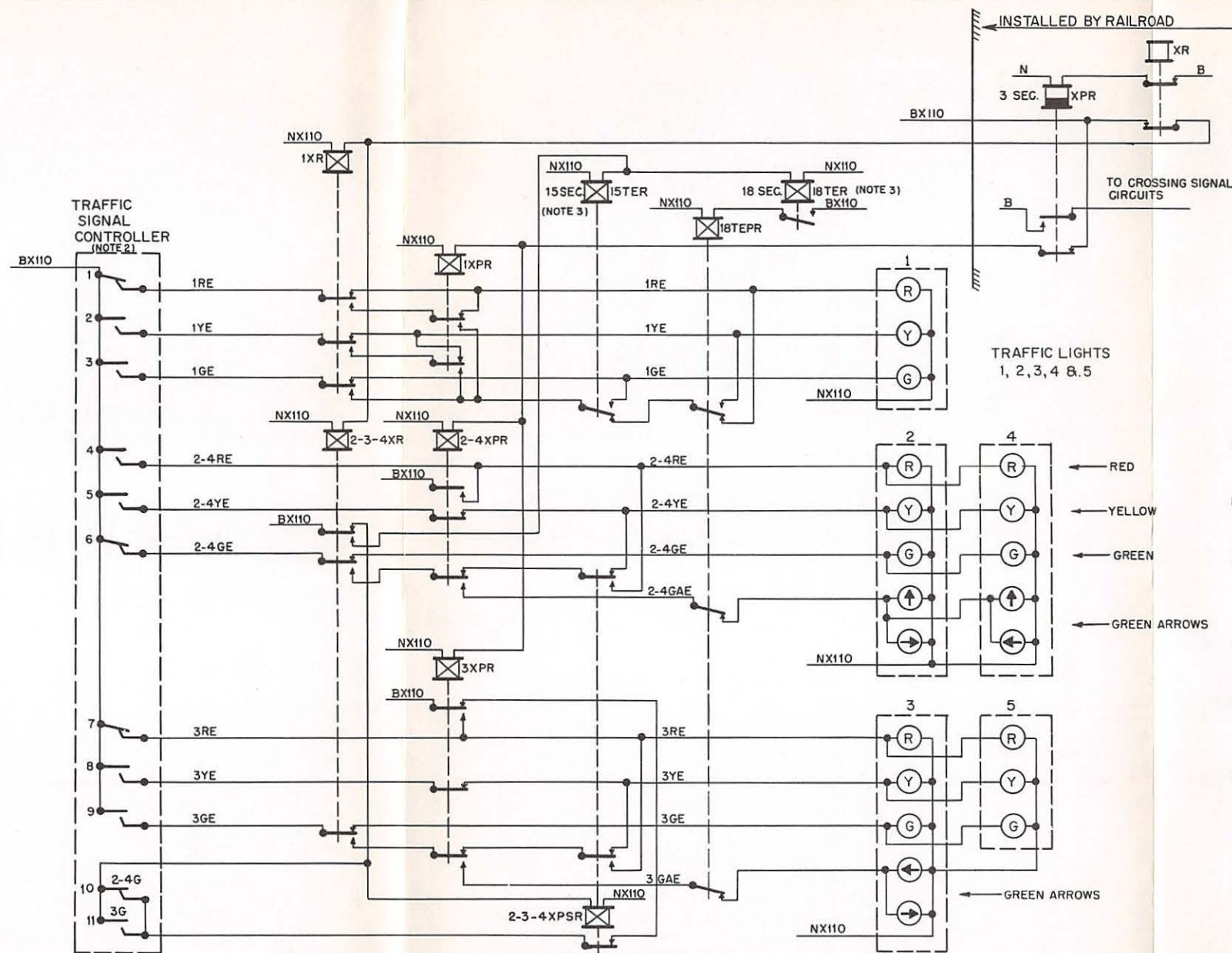
⊙ — DENOTES EXTENSION UNIT CONTROL CODE CHARACTER CONNECTION. LETTER INDICATES EXTENSION UNIT, NUMBER INDICATES RESPECTIVE FUNCTION ASSIGNMENT.

AAR
SIG. SEC.
8082A



	CODE AND FUNCTION ASSIGNMENTS														
	CONTROL CODE								INDICATION CODE						
	LCS OR EXT.	1	2	3	4	5	6	7	9	10	11	12	13	14	15
OFFICE POST															
FIELD POST		9	10	11	12	13	14	15	1	2	3	4	5	6	7
FUNCTION	LCS	3NWS	MCS	3RWS	4LFS	4LHS	4RFS	4RHS	3NWK	3TK	3RWK	4LBK	4LGK		4RGK
ASSIGNMENT	EXT.	6RHS							6LGK	11TK	6RGK	4RBK			

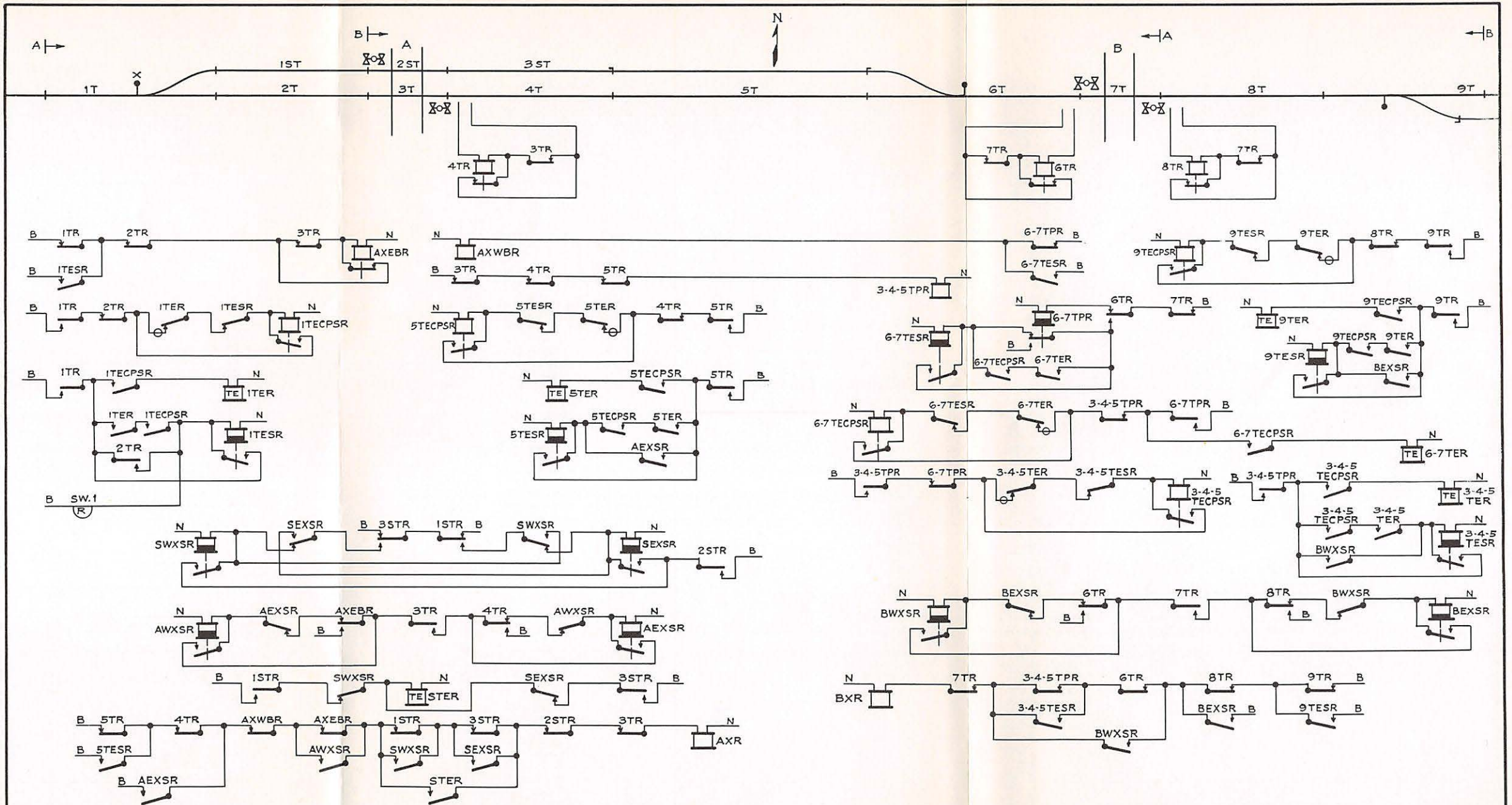
CIRCUITS FOR MODIFIED TRAFFIC CONTROL SYSTEM
USING TWO WIRE LINE CONTROL AND SPRING-POWER ENDS OF SIDING
(CONTROL MACHINE CIRCUITS)



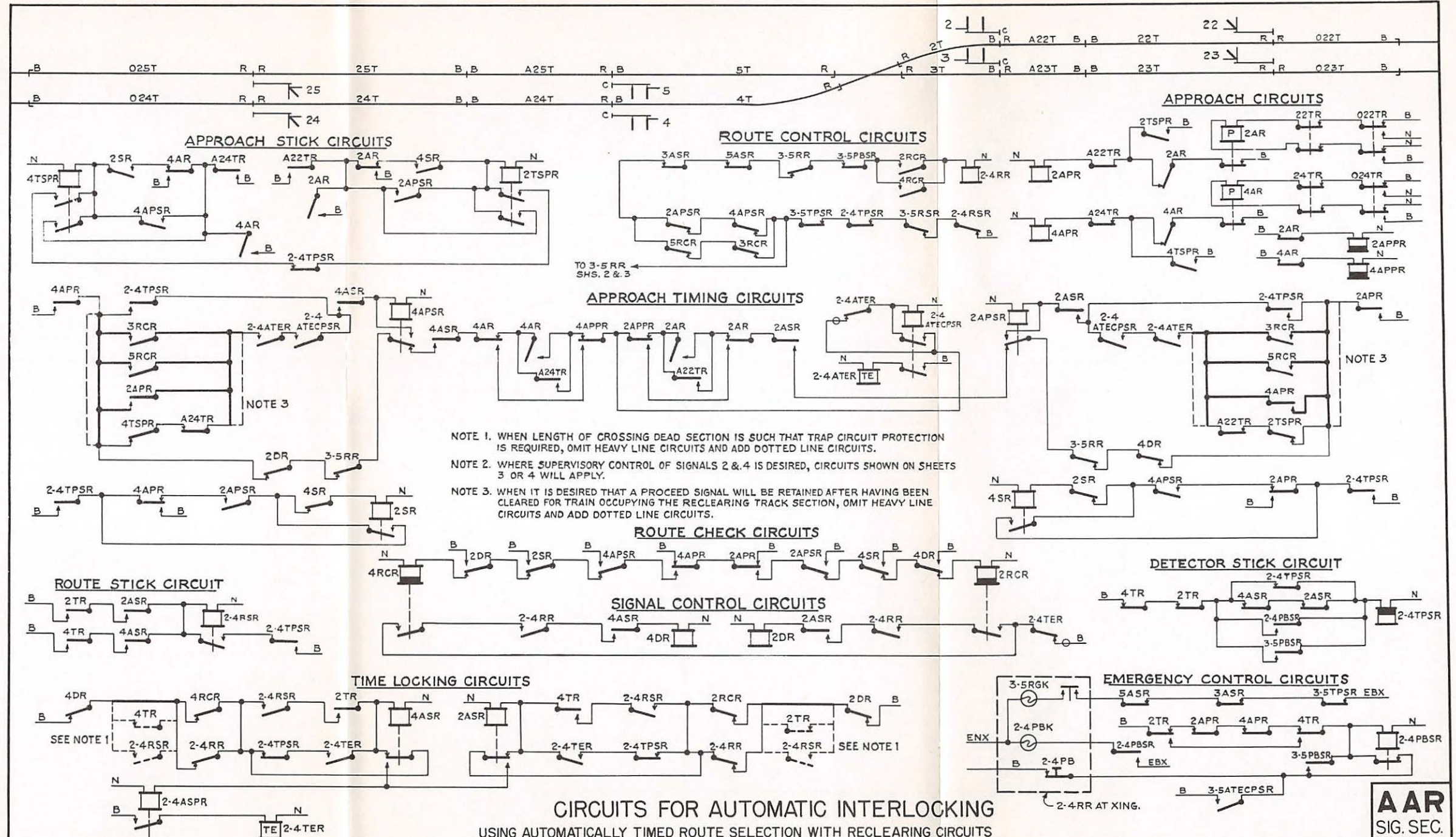
NOTES:

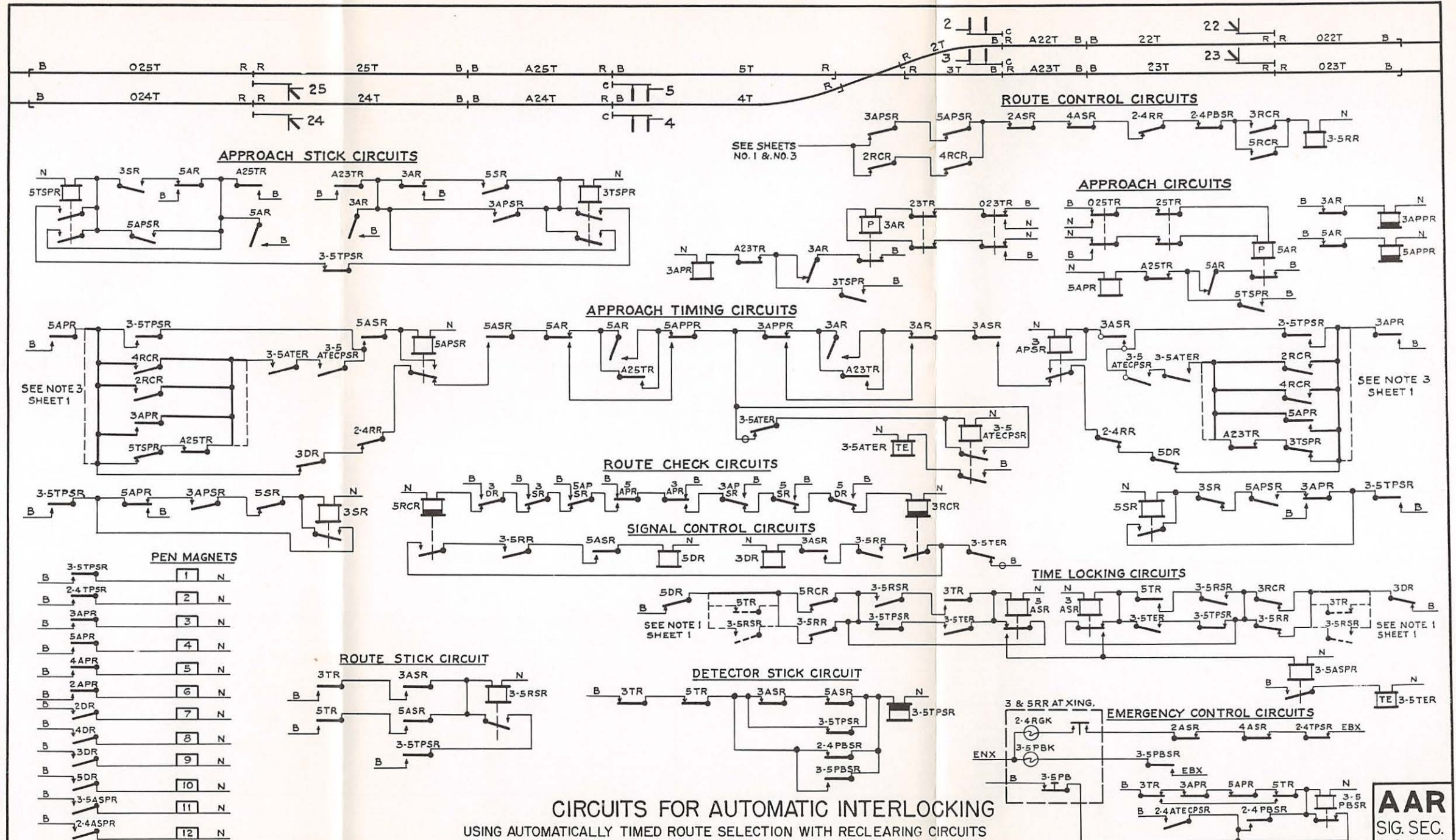
- NOTE 1. HIGHWAY GRADE CROSSING SIGNALS BEGIN TO OPERATE THREE SECONDS AFTER TRAIN ENTERS APPROACH CIRCUIT AND CONTINUE TO OPERATE UNTIL TRAIN CLEARS THE CROSSING.
- NOTE 2. TRAFFIC SIGNAL CONTROLLER CAN BE SYNCHRONOUS OR OTHER TYPE. CONTACTS ARE SHOWN IN POSITION TO DISPLAY GREEN FOR MAIN STREET AND RED FOR CROSS STREET.
- NOTE 3. 15TER AND 18TER ARE NORMALLY DE-ENERGIZED SYNCHRONOUS TIME RELAYS ADJUSTABLE 0 TO 35 SECONDS. WHEN ENERGIZED, IT CLOSSES FRONT CONTACT FOR THE TIME SET THEN OPENS FRONT CONTACT AND CLOSSES BACK CONTACT. WHEN THE RELAY IS AGAIN DE-ENERGIZED IT RESETS FOR NEXT OPERATION.
- NOTE 4. OTHER AC RELAYS SHOWN ARE ORDINARY QUICK ACTING, USUALLY HAVING 3 FB CONTACTS OF NOT LESS THAN 5 AMP CAPACITY AND COILS CONSUMING NOT MORE THAN 5 WATTS AT 115 VOLTS.
- NOTE 5. DURATION OF GREEN CLEARING PERIOD ON TRAFFIC LIGHT 1 NEEDS TO BE VARIED ACCORDING TO THE DISTANCE BETWEEN SIGNAL "A" AND TRAFFIC LIGHT 1. CLEARING PERIOD SHOULD PROVIDE A MINIMUM GREEN OF 3½ SECONDS PER CAR TO CLEAR THE TRACKS.
- NOTE 6. SHOULD IT BE DESIRABLE TO ARRANGE SIGNAL 5 ALWAYS TO GO TO RED BEFORE SIGNAL 1, THIS CAN BE DONE BY REARRANGING THE CONTROL OF CONTACTS 1, 2 AND 3 OF THE TRAFFIC SIGNAL CONTROLLER. THIS WILL KEEP TRAFFIC CLEAR OF THE RAILROAD TRACKS WHEN TRAFFIC IS LINED CLEAR FOR SIGNALS 2 AND 4.

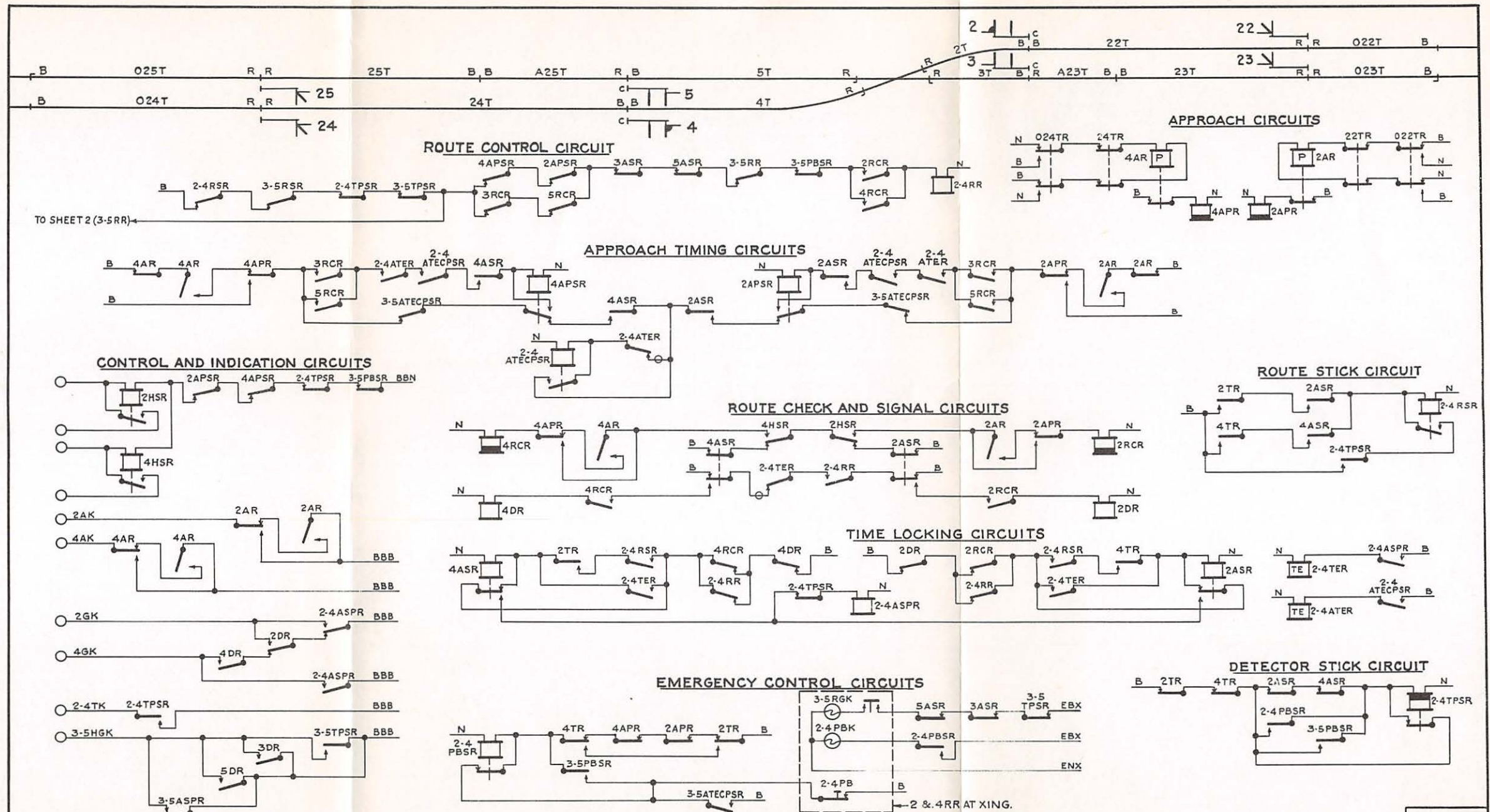
CIRCUITS FOR INTER-CONNECTION OF RAILWAY-HIGHWAY
 GRADE CROSSING AND HIGHWAY TRAFFIC CONTROL SIGNALS



CONTROL CIRCUITS FOR AUTOMATIC HIGHWAY GRADE CROSSING SIGNALS







NOTE 1: THESE CIRCUITS WILL VARY WITH THE TYPE OF CODE SYSTEM EMPLOYED.

USING AUTOMATICALLY TIMED ROUTE SELECTION WITHOUT AUTOMATIC RECLEARING CIRCUIT, AND WITH SUPERVISORY CONTROL OF SIGNALS 2 & 4.

CIRCUITS FOR AUTOMATIC INTERLOCKING

SEPT. 1958

AAR
SIG. SEC.
8085A

RULES OF ORDER

Effective April 6, 1938

Revised: December 6, 1938; May 22, 1940; March 12, 1941; May 17, 1944;
December 11, 1946; June 8, 1949; May 7, 1952.

1. **REPRESENTATIVES:** The representatives of Member Roads in the Signal Section shall be employees engaged in an official or supervisory capacity in the design, construction or maintenance of railroad signaling devices. Included within this category shall be Signal Superintendents, Signal Engineers and their Assistants, Signal Inspectors, Chief Draftsmen, Signal Supervisors and Assistant Signal Supervisors, or others with corresponding duties.
2. **AFFILIATED MEMBERS:**
 - (a) **RAILROAD AFFILIATED MEMBERS:** A member of a State or Federal regulatory body, or a railroad employee not embraced within the provisions of paragraph 1 (including those temporarily relieved from service or furloughed) may become a **RAILROAD AFFILIATED MEMBER** upon approval of his application by the Committee of Direction. Such a member will pay an annual fee of \$3.00 (which may be changed from year to year at the discretion of the Committee of Direction), on January 1st of each year, for which he will receive currently the Advance Notices and Minutes of the Section.
 - (b) **AFFILIATED MEMBERS:** A representative of an organization or an individual engaged in the design, manufacture, sale or construction of signal devices or materials applicable thereto, or one who is qualified by his business relations and practical experience to cooperate with the Section, may become an **AFFILIATED MEMBER** thereof upon approval of his application by the Committee of Direction. An Affiliated Member will pay an annual fee of \$6.00 (which may be changed from year to year at the discretion of the Committee of Direction), on January 1st of each year, for which he will receive currently the Advance Notices and Minutes of the Section.
 - (c) A Railroad Affiliated or an Affiliated Member shall have the rights and privileges accorded a Member Road representative except voting or the holding of office.
 - (d) A Railroad Affiliated or an Affiliated Member may be appointed as a Consulting Member of any Standing Committee upon the approval of the Committee of Direction.
3. **LIFE MEMBERS:** Life membership may be conferred upon members who retire from active work. They shall have been active in the affairs of the Signal Section and its predecessors and their total term of membership shall have been not less than twenty-five years. Their rights and privileges shall be continued without change. A proposal to confer Life Membership must be signed by five voting representatives of Member Roads and five representatives of Member Roads, stating their reason for

making such proposal. Proposal shall be duly considered at a meeting of the Committee of Direction and then submitted to a vote by letter to the Committee of Direction membership for approval.

Officers and Committees

4. The Officers of the Section shall consist of a Chairman, First Vice-Chairman, Second Vice-Chairman, and Secretary.

- (a) The Chairman and Vice-Chairmen shall be selected by the Committee of Direction on or before November 1st. Their terms of office shall be one year from January 1st or until their successors are selected and qualified. A Chairman or Vice-Chairman having served a full term shall not succeed himself.
- (b) The Secretary will be appointed by the Committee of Direction. His salary shall be named by that Committee subject to the approval of the Vice-President, Operations and Maintenance Department of the Association.
- (c) The COMMITTEE OF DIRECTION will consist of twelve members, as follows: The Chairman, the First Vice-Chairman, the Second Vice-Chairman, the latest Past Chairman, one member from New England or Canada, three members from the East, one member from the South and three members from the West.

The territorial representatives, except when filling vacancies, shall serve four years and their term of office will expire on December 31st of the fourth year.

Vacancies in official positions or of territorial representatives shall be filled until the next election, by the Committee of Direction.

One Vice-Chairman shall be selected from Eastern Territory and one from Western Territory. For this purpose the Eastern Territory will consist of all territory operating under Eastern and Atlantic Standard Time. All other territory will be known as Western Territory. The location of the official's headquarters will determine whether he is in the Eastern or Western territory.

- (d) The Standing Committees of the Section will be as follows:

- I—Economics of Railway Signaling
- II—Interlocking
- III—Signal Shop Practice
- IV—Automatic Block Signaling
- V—Contracts and Instructions
- VI—Designs
- VII—Materials Research
- VIII—Highway Grade Crossing Protection
- IX—Wire and Cable
- X—Signaling Practice
- XI—Electronics
- XII—Circuit Design

The representation of Member Roads on these committees will be, when practicable, territorially selected, in approximately the same proportion as that of the Committee of Direction, the personnel to be named each year by the Committee of Direction.

Duties of Officers

5. The CHAIRMAN shall have general supervision over the affairs of the Section and shall preside at meetings of the Section and at meetings of the Committee of Direction.
6. The FIRST VICE-CHAIRMAN, in the absence of the Chairman, shall perform the duties of the Chairman. He shall perform such other duties as may be assigned to him by the Chairman.
7. The SECOND VICE-CHAIRMAN, in the absence of both the Chairman and First Vice-Chairman, shall perform the duties of the Chairman. He shall perform such other duties as may be assigned to him by the Chairman.
8. (a) The SECRETARY shall devote his entire time to the work of the Section and will perform the usual duties of that office and such other duties as may be assigned to him by the Chairman.
(b) He shall receive on or before November 20th of each year the report of the Committee on Nominations, as elsewhere provided for, and will submit to the voting representatives of Member Roads, not later than November 29th, for letter ballot vote, the nominations contained in that report, to fill the vacancies in the membership of the Committee of Direction. He shall appoint three Tellers from representatives of Member Roads to assist him in counting the ballots, who shall certify the count thereof, with him, to the Committee of Direction. He shall announce the result of the ballot to the Members promptly.
(c) He shall furnish, free of charge, to each representative of a Member Road, designated by such road, one copy of all circulars, Advance Notices and Minutes.
(d) He shall furnish to each Railroad Affiliated, Affiliated and Life Member one copy of all circulars, Advance Notices and Minutes.

Duties of Committees

9. The COMMITTEE OF DIRECTION shall:
 - (a) Exercise general supervision over the interests and affairs of the Section.
 - (b) Be empowered to act on behalf of the Section in the interim between meetings and submit at each meeting a report covering its actions.
 - (c) Examine and decide what portion of communications, papers and reports shall be submitted to the meetings. It shall determine which, if any, of the subjects presented by the various committees shall be referred to the General Committee of the Engineering Division.
 - (d) Appoint on or before October 1st of each year a Committee on Nominations consisting of representatives of five Member Roads, who shall not be members of the Committee of Direction.
 - (e) Appoint additional committees as required.
 - (f) Submit to the Vice-President, Operations and Maintenance Department, detail of contemplated financial requirements for conducting the work of the Section as required or as called for by that official.

- (g) Call Annual meetings of the Section if in its judgment conditions warrant.
 - (h) Call meetings of the Section upon not less than thirty days' notice to each member. It **MUST** call a special meeting of the Section upon the request in writing of a majority of the voting members of Member Roads.
 - (i) Publish Manual of Recommended Practice, in which shall be included such approved Specifications, Drawings, Findings and Conclusions of the Section as the Committee of Direction may find advisable.
10. The COMMITTEE ON NOMINATIONS, appointed as prescribed above, shall report to the Secretary on or before November 20th each year at least two nominations for each impending vacancy to replace the territorial representatives on the Committee of Direction.
- The duties of the Standing Committees shall be as follows:
11. COMMITTEE I—ECONOMICS OF RAILWAY SIGNALING. Study and report on the economy, if any, of the various signal systems, interlocking, train control, cab signals and other signaling projects.
12. COMMITTEE II—INTERLOCKING. Prepare specifications for the various types of interlockings and submit reports on subject-matters relating thereto.
13. COMMITTEE III—SIGNAL SHOP PRACTICE. Study and report on signal shop practices.
14. COMMITTEE IV—AUTOMATIC BLOCK SIGNALING. Prepare specifications for the various types of automatic block systems and submit reports on subject-matters relating thereto.
15. COMMITTEE V—CONTRACTS AND INSTRUCTIONS. Prepare recommended forms for use in connection with signaling contracts and prepare instructions relating to signal maintenance.
16. COMMITTEE VI—DESIGNS. Prepare detailed drawings for standardization purposes and make any special study or investigation assigned to it by the Committee of Direction.
17. COMMITTEE VII—MATERIALS RESEARCH. Make such investigation of materials used in connection with signaling as directed by the Committee of Direction and submit reports on its conclusions.
18. COMMITTEE VIII—HIGHWAY GRADE CROSSING PROTECTION. Prepare requisites for highway grade crossing protection and submit matters of interest relating thereto.
19. COMMITTEE IX—WIRE AND CABLE. Prepare specifications for wire and cable, overhead and underground lines and any recommendations relating thereto which will be of interest to the Section.

20. **COMMITTEE X—SIGNALING PRACTICE.** Prepare requisites for the various types of interlocking and block signaling systems, make recommendations having reference to the signal indications which should be given as the varied conditions on railroads require, also submit reports on such other matters as may be assigned by the Committee of Direction.
21. **COMMITTEE XI—ELECTRONICS.** Investigate and report on the use of electronics in connection with railway signal systems, interlocking, centralized traffic control, and highway grade crossing protection.
22. **COMMITTEE XII—CIRCUIT DESIGN.** Prepare typical circuits representative of approved practices and requisites for railroad signaling.
23. **REPRESENTATION OF THE SECTION UPON GENERAL COMMITTEE OF THE ENGINEERING DIVISION:** The five representatives of the Signal Section upon the General Committee of the Engineering Division shall be the Chairman, First Vice-Chairman, Second Vice-Chairman, and two members of the Committee of Direction to be selected by it.

24. **RECOMMENDED PRACTICES:**

Any definition, nomenclature, specification, recommended construction or recommended practice or any proposition having for its objective the formal declaration of the Section upon any matter of importance shall be presented in writing (accompanied by drawings if the latter are necessary for a clear understanding of the subject).

Such submissions will be presented to the Section at its Annual meeting for discussion, and following vote to decide whether or not the proposition shall be submitted to the voting members of Member Roads for adoption or rejection by letter ballot. If the vote to submit is affirmative, the Secretary within three months from the date of the meeting will distribute the ballots with a copy of the Minutes of the meeting, requesting their return within thirty days, naming the date. Ballots mailed after that date, as shown by the postmark, will not be counted. The Secretary shall announce the result of the ballot promptly to the Members. Ballots and envelopes shall be preserved for at least two years from date of announcement. The voting power of the Member Roads shall be as named in paragraph 26.

25. **VOTING AT MEETINGS OF SECTION:** Vote may be taken viva voce, by rising, by roll call or by ballot. Each Member Road shall be entitled to one vote, the ranking officer of a road present at any meeting being recognized as the voting representative of that road, unless otherwise designated by it. The vote of a majority of the Member Roads represented shall be required to decide any question, motion or resolution unless otherwise ordered, except that in the consideration of submitting a question to the letter ballot vote of the Member Roads, all representatives of Member Roads present at any meeting may vote. Thirty representatives of Member Roads shall constitute a quorum.

26. LETTER BALLOTS:

Letter ballots may be taken upon any subject by order of the Committee of Direction and *must* be taken on all questions affecting physical property. The voting power of the Member Roads shall be proportionate to ownership of signal equipment, one vote being counted for each

- 400 signals operating in two positions;
- 250 signals operating in three or four positions;
- 200 interlocked switches, power operated;
- 400 interlocked switches, manually operated;
- 250 highway crossings, automatically protected;
- 1600 train control inductors or loop circuits;
- 800 train control ramp (energized) magnet or coded circuits.

A fraction of a vote in the total of all items, if greater than one-half, shall be counted as one. Each Member Road shall have at least one vote.

Any proposition for which a majority of the votes are affirmative, shall be considered adopted.

27. ORDER OF BUSINESS: The order of business at meetings of the Section shall, unless otherwise directed by a majority of the members present, be as follows:

- Approval of Minutes of Last Meeting;
- Reports of Standing Committees;
- Reports of Special Committees;
- Unfinished Business;
- New Business.

28. Roberts' Rules of Order shall govern the proceedings of the Section, including amendment of these Rules of Order.

RESULT OF LETTER BALLOT ON SUBJECTS APPROVED AT THE
ANNUAL MEETING, SEPTEMBER 10, 11 AND 12, 1951

All subjects submitted to letter ballot were unanimously approved,
as follows:

	For	Against
<i>Committee I—Economics of Railway Signaling</i>		
Conclusions and Findings. (To be removed from Manual Part 103.).....	1101	0
<i>Committee II—Interlocking</i>		
Specification 258-51—Interlocking. (New.).....	1101	0
Specification for Centralized Traffic Control. (Superseding Specification 149-43, Manual Part 97.).....	1101	0
Specification for Electro-Pneumatic Interlocking. (Superseding Specification 67-43, Manual Part 79.).....	1101	0
Specification for Electric Interlocking. (Superseding Specification 65-42, Manual Part 75.).....	1101	0
Specification for Automatic Interlocking. (Superseding Specification 141-43, Manual Part 208.).....	1101	0
Specification for All-Relay Interlocking. (Superseding Specification 203-44, Manual Part 209.).....	1101	0
Specification for Electro-Mechanical and Mechanical Interlocking. (Superseding Specification 66-41, Manual Part 76.).....	1101	0
Requisites for Movable Bridge Interlocking. (Superseding Requisites for Movable Bridge Interlocking, Manual Part 64.).....	1101	0
Specification 76-51—Electric Interlocking Machine. (Superseding Specification 76-49, Manual Part 85.).....	1101	0
Specification 75-51—Mechanical Interlocking Machine, S. & F. Locking. (Superseding Specification 75-46, Manual Part 82.).....	1101	0
Specification 114-46—Mechanical Interlocking Machine, Style "A" Locking. (To be removed from Manual Part 83.).....	1101	0
Requisites for Mechanically Locking the Levers of Interlocking Machines. (Superseding Requisites for Mechanically Locking the Levers of Interlocking Machines, Manual Part 99.).....	1101	0
Specification 198-51—Electric Switch Locks. (Superseding Specification 198-46, Manual Part 109.).....	1101	0
Specification 150-51—Centralized Traffic Control Machine. (Superseding Specification 150-43, Manual Part 98.).....	1101	0
Specification 138-51—Mechanically Operated Circuit Controller for Interlocking Machine Lever. (Superseding Specification 138-44, Manual Part 197.).....	1101	0

	For	Against
<i>Committee IV—Automatic Block Signaling</i>		
Specification 135-51—Track Circuit Bonding. (Superseding section 6-e of Specification 135-50, Manual Part 22.).....	1101	0
Formulae for Computing Minimum Allowable Resistance Between Track Battery and Track and for Computing Related Current and Voltage Data. (Superseding Tables I-IV, inclusive, of Formulae for Computing Minimum Allowable Resistance Between Track Battery and Track and for Computing Related Current and Voltage Data, Manual Part 132.).....	1101	0
Requisites for Track Circuits. (New.).....	1101	0
Requisites for Automatic Block Signaling Circuits. (Superseding Requisites for Automatic Block Signaling Circuits, Manual Part 34.).....	1101	0
Instructions for Minimizing the Effect of Foreign Current on Direct Current Track Circuits. (Superseding Instructions for Minimizing the Effect of Foreign Current on Direct Current Track Circuits, Manual Part 127.).....	1101	0
Requisites for Electric Locks Applied to Hand-Operated Switches for Protection of Main Track Movements. (Superseding Requisites for Electric Locks Applied to Hand-Operated Switches for Protection of Main Track Movements, Manual Part 211.).....	1101	0
Specification 60-51—Installation of Made Ground. (Superseding Specification 60-40, Manual Part 92.).....	1101	0
Specification 52-51—Low-Voltage Lightning Arresters. (Superseding Specification 52-43, Manual Part 95.).....	1101	0

Committee V—Contracts and Instructions

Definitions for Technical Terms Used in Signaling. (To be included in Manual Part 55.).....	1101	0
Specification 257-51—Ground Resistance Testing Instrument. (New.).....	1101	0
Instructions for Automatic Block Signal Systems. (Superseding Instructions for Automatic Block Signal Systems, Manual Part 102.).....	1101	0
Instructions for Interlockings. (Superseding Instructions for Automatic Interlocking, Manual Part 59, and Instructions for Interlocking, Manual Part 138.).....	1101	0
Instructions for Signal Protection for Movable Bridges. (Superseding Instructions for Signal Protection for Movable Bridges, Manual Part 233.).....	1101	0
Instructions for Light and Semaphore Signals. (Superseding Instructions 1 to 57, inclusive, of Instructions for Light and Motor Semaphore Signals, Manual Part 54.).....	1101	0

	For	Against
<i>Committee V—Contracts and Instructions—Continued</i>		
Instructions for Time Releases Applied to Signal Apparatus. (Superseding Instructions for Time Releases Applied to Signal Apparatus, Manual Part 128.).....	1101	0
Instructions for Switch Circuit Controllers. (Superseding Instructions for Switch Circuit Controllers, Manual Part 134.).....	1101	0
Instructions for Electric Locking. (Superseding Instructions for Electric Locking, Manual Part 199.).....	1101	0

Committee VI—Designs

Specification 231-51—"No Right Turn"—"No Left Turn" Illuminated Sign. (Superseding section 7-a and alternate requisites section R-7-a of Specification 231-50, Manual Part 237.).....	1101	0
Specification 155-51—Railroad Highway Grade Crossing Signs. (Superseding Specification 155-46, Manual Part 44.).....	1101	0
Specification 255-51—Reflex-Reflecting Sheet Material. (New.).....	1101	0
A.A.R. Sig. Sec. 1642F—Railroad Crossing Sign—90 Degree Reflector Type for 4 to 8-Inch Pipe—Assembly. (Superseding A.A.R. Sig. Sec. 1642E in the Manual.).....	1101	0
A.A.R. Sig. Sec. 1645E—Number of Tracks Sign—Reflector Type for 4 to 8-Inch Pipe—Assembly. (Superseding A.A.R. Sig. Sec. 1645D in the Manual.).....	1101	0
A.A.R. Sig. Sec. 1646E—Stop on Red Signal Sign—Reflector Type for 4 to 8-Inch Pipe—Assembly. (Superseding A.A.R. Sig. Sec. 1646D in the Manual.).....	1101	0
A.A.R. Sig. Sec. 1648E—Stop When Swinging Sign—Reflector Type for 4 to 8-Inch Pipe—Assembly. (Superseding A.A.R. Sig. Sec. 1648D in the Manual.).....	1101	0
A.A.R. Sig. Sec. 1692D—Railroad Crossing Sign—50 Degree Reflector Type for 4 to 8-Inch Pipe—Assembly. (Superseding A.A.R. Sig. Sec. 1692C in the Manual.).....	1101	0
A.A.R. Sig. Sec. 1643F—Front Plates for Railroad Crossing Sign—90 Degree Reflector Unit Type—Details. (Superseding A.A.R. Sig. Sec. 1643E in the Manual.).....	1101	0
A.A.R. Sig. Sec. 1693E—Front Plates for Railroad Crossing Sign—50 Degree Reflector Unit Type—Details. (Superseding A.A.R. Sig. Sec. 1693D in the Manual.).....	1101	0
A.A.R. Sig. Sec. 1702B—Front and Back Plates for Stop on Red Signal Sign—Reflector Unit Type—Details. (Superseding A.A.R. Sig. Sec. 1702A in the Manual.).....	1101	0
A.A.R. Sig. Sec. 1703B—Front and Back Plates for Stop When Swinging Sign—Reflector Unit Type—Details. (Superseding A.A.R. Sig. Sec. 1703A in the Manual.).....	1101	0

Committee VI—Designs—Continued

	For	Against
A.A.R. Sig. Sec. 1700B—Front and Back Plates for Number of Tracks Sign—Reflector Unit Type—Details. (Superseding A.A.R. Sig. Sec. 1700A in the Manual.).....	1101	0
A.A.R. Sig. Sec. 1462B—Highway Crossing Signal—Flashing Light Type with Extended Lights and Pedestal Mounted Gate—Assembly. (Superseding A.A.R. Sig. Sec. 1462A in the Manual.).....	1101	0
A.A.R. Sig. Sec. 1489E—Highway Crossing Signal—Flashing Light Type with Suspended Lights and Mast Mounted Gate—Assembly. (Superseding A.A.R. Sig. Sec. 1489D in the Manual.).....	1101	0
A.A.R. Sig. Sec. 1691E—Highway Crossing Sign—50 Degree Reflector Type—Assembly. (Superseding A.A.R. Sig. Sec. 1691D in the Manual.).....	1101	0
A.A.R. Sig. Sec. 1651F—Highway Crossing Signal—Wig-Wag Type with Stop When Swinging Sign—Assembly. (Superseding A.A.R. Sig. Sec. 1651E in the Manual.).....	1101	0
A.A.R. Sig. Sec. 1652F—Highway Crossing Signal—Wig-Wag Type with Stop Sign—Assembly. (Superseding A.A.R. Sig. Sec. 1652E in the Manual.).....	1101	0
A.A.R. Sig. Sec. 1653F—Highway Crossing Signal—Flashing Light Type with Stop on Red Signal Sign—Assembly. (Superseding A.A.R. Sig. Sec. 1653E in the Manual.).....	1101	0
A.A.R. Sig. Sec. 1654F—Highway Crossing Signal—Flashing Light Type with Stop Sign—Assembly. (Superseding A.A.R. Sig. Sec. 1654E in the Manual.).....	1101	0
A.A.R. Sig. Sec. 1686F—Highway Crossing Signal—Flashing Light Type, 6 Ft. and 8 Ft. Cantilever Span—Assembly. (Superseding A.A.R. Sig. Sec. 1686E in the Manual.).....	1101	0
A.A.R. Sig. Sec. 1688D—Highway Crossing Signal—Flashing Light Type, 10 Ft. and 12 Ft. Cantilever Span—Assembly. (Superseding A.A.R. Sig. Sec. 1688C in the Manual.).....	1101	0
A.A.R. Sig. Sec. 1705A—Front Plates for 50 Degree Railroad Crossing Sign—Reflex-Reflecting Sheet Type for Back Plates 17041 and 17042—Details. (New.).....	1101	0
A.A.R. Sig. Sec. 1706A—Front Plates for 90 Degree Railroad Crossing Sign—Reflex-Reflecting Sheet Type for Back Plates 17011 and 17012—Details. (New.).....	1101	0
A.A.R. Sig. Sec. 1707A—Front Plates for Number of Tracks Sign—Reflex-Reflecting Sheet Type for Back Plate 17001—Details. (New.).....	1101	0
A.A.R. Sig. Sec. 1708A—Front Plate for Stop on Red Signal Sign—Reflex-Reflecting Sheet Type for Back Plate 17021—Detail. (New.).....	1101	0
A.A.R. Sig. Sec. 1709A—Front Plate for Stop When Swinging Sign—Reflex-Reflecting Sheet Type for Back Plate 17031—Details. (New.).....	1101	0

Sept. 1952]

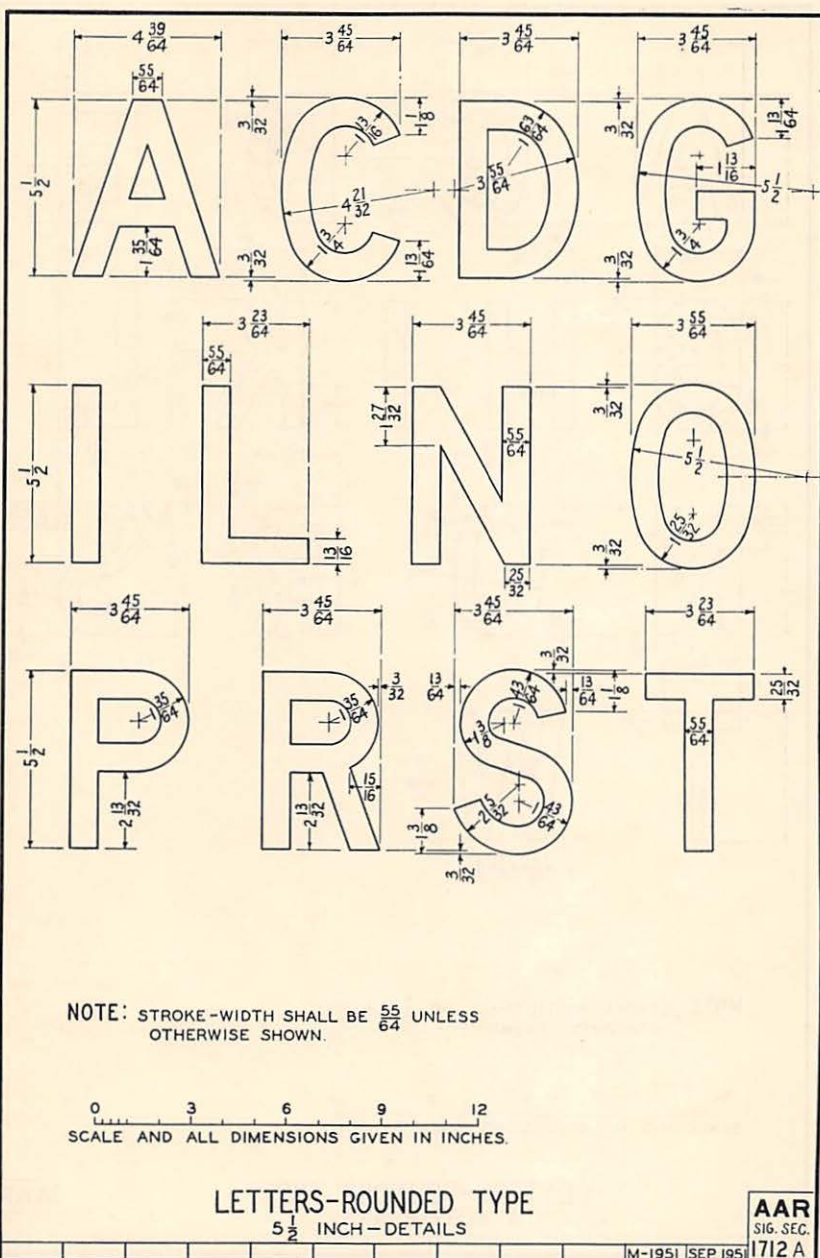
	For	Against
<i>Committee VI—Designs—Continued</i>		
A.A.R. Sig. Sec. 1715A—50 Degree Railroad Crossing Sign—Reflex-Reflecting Sheet Type for 4 to 8-Inch Pipe—Assembly. (New.).....	1101	0
A.A.R. Sig. Sec. 1716A—Plates for 50 Degree Railroad Crossing Sign—Reflex-Reflecting Sheet Type—Details. (New.).....	1101	0
A.A.R. Sig. Sec. 1717A—90 Degree Railroad Crossing Sign—Reflex-Reflecting Sheet Type for 4 to 8-Inch Pipe—Assembly. (New.).....	1101	0
A.A.R. Sig. Sec. 1718A—Plates for 90 Degree Railroad Crossing Sign—Reflex-Reflecting Sheet Type—Details. (New.).....	1101	0
A.A.R. Sig. Sec. 1719A—Number of Tracks Sign—Reflex-Reflecting Sheet Type for 4 to 8-Inch Pipe—Details and Assembly. (New.).....	1101	0
A.A.R. Sig. Sec. 1720A—Stop on Red Signal Sign—Reflex-Reflecting Sheet Type for 4 to 8-Inch Pipe—Details and Assembly. (New.).....	1101	0
A.A.R. Sig. Sec. 1721A—Stop When Swinging Sign—Reflex-Reflecting Sheet Type for 4 to 8-Inch Pipe—Details and Assembly. (New.).....	1101	0
A.A.R. Sig. Sec. 1712A—Letters—Rounded Type—5½ Inch—Details.* (New.).....	1101	0
A.A.R. Sig. Sec. 1713A—Letters—Rounded Type—4 Inch—Details.* (New.).....	1101	0
A.A.R. Sig. Sec. 1714A—Numerals—Rounded Type—5½ Inch—Details.* (New.).....	1101	0

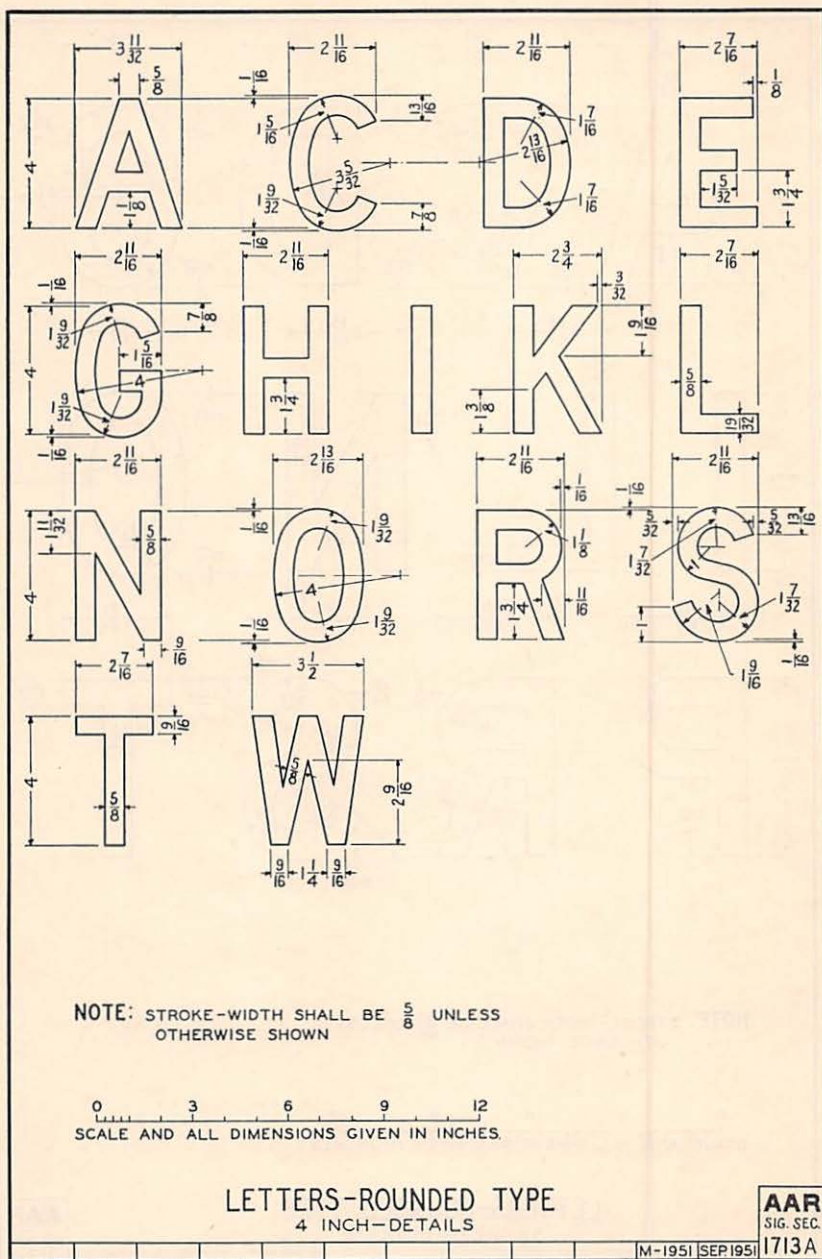
Committee VII—Materials Research

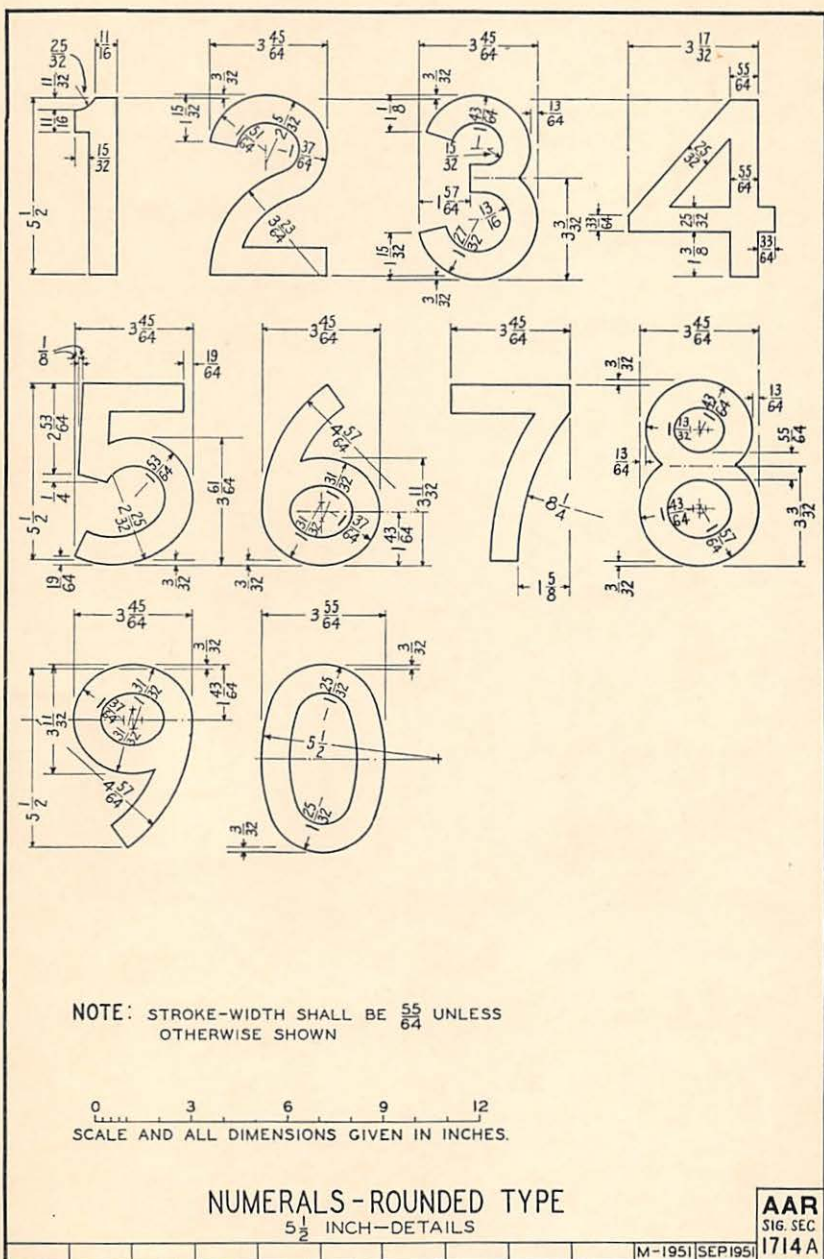
Specification 144-51—Dry Process Porcelain Insulation. (Superseding Specification 144-39, Manual Part 80.).....	1101	0
Specification 120-51—Painting. (Superseding Specification 120-50, Manual Part 110.).....	1101	0
Specifications for Various Types of Steel. (Superseding Specifications for Various Types of Steel, Manual Part 154.).....	1101	0

* As a result of revision of drawings on the floor of the 1951 Annual Meeting, to show rounded type letters and numerals, Committee VI—Designs found it necessary to prepare three additional drawings covering details of such letters and numerals. On completion, these drawings: namely, A.A.R. Sig. Sec. 1712A, 1713A and 1714A, were approved by the Signal Section Committee of Direction for inclusion in the 1951 Letter Ballot as part of Committee VI's submission. See pages 345, 346 and 347.

	For	Against
<i>Committee X—Signaling Practice</i>		
Requisites for Protection for Spring Switches. (Superseding Requisites for Spring Switches, Manual Part 10.).....	1101	0
Requisites for Automatic Block Signaling Systems. (Superseding Requisites for Automatic Block Signaling Systems, Manual Part 87.).....	1101	0
Requisites for Take or Leave Siding Indicator. (Superseding Requisites for Take Siding Indicator and Leave Siding Indicator for Non-Interlocked Switch, Manual Part 71.)....	1101	0
Requisites for Interlocking. (Superseding Requisites for Interlocking, Manual Part 94.).....	1101	0







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SIGNAL SECTION, A.A.R.

ADVANCE NOTICE

September 29, 30 and October 1, 1952